No. 329

A MICROMETER X-Y TABLE

– An innovative project using 3D printed parts.

MODEL ENGINEERS' WORKSHOP

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS JULY 2023 ISSUE 329 WWW.MODEL-ENGINEER.CO.UK

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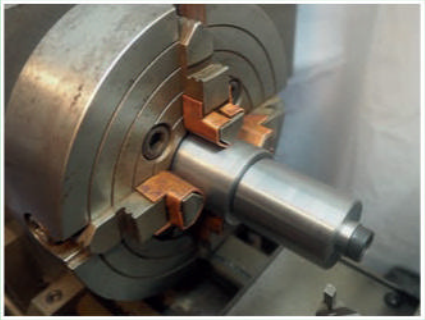

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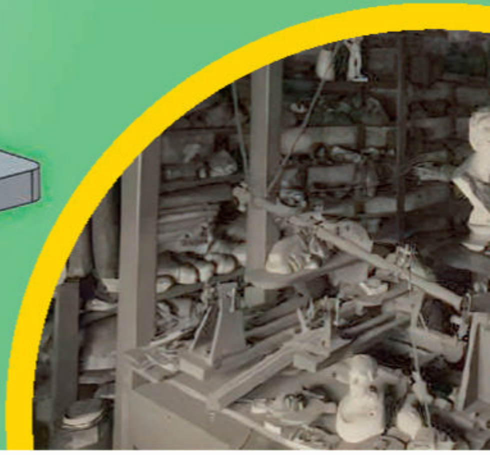

WORKSHOP TALES.

James Watt, the inventor who released the true potential of steam power.

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Jul 23

INSIDE THIS PACKED ISSUE:

- A COLLET STOP DESIGNED FOR THE POPULAR 5C SYSTEM.
- UNDERSTANDING GLANDS AND PIPE FITTINGS.
- AUTOMATIC SCREWCUTTING TOOL – COMPLETE THE LATHE ACCESSORY.
- MYFORD LEVER TAILSTOCK.
- EAGLE SURFACE GRINDER STRIPDOWN.
- ARCHIVE TOOLING: A VERTICAL MILLING ATTACHMENT AND FORMING HOLES IN THIN METAL.
- MILLING THIN MATERIALS.
- SAVING MONEY BY SALVAGING LARGE DIAMETER DRILLS.
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The next will be on sale on July 22, 2022.

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On the Editor's Bench

The Waverley

This month my partner and I will be taking a day cruise around the Bristol Channel on the P.S. Waverley (the excellent photograph is by Robert Mason). Waverley is the last seagoing paddle steamer in the world but has some very special memories for me as during my youth I enjoyed several such trips on Waverley and the M.V. Balmoral in the seventies. In particular, I remember a visit to Waverley's engine room, courtesy of the Chief Engineer who happened to a be a friend of my father. In the eighties both ships were part of P & A Campbell's White Funnel fleet. Since those days Balmoral has had a bit of a chequered history, at one point appearing to be destined to be a static restaurant ship, being reprieved by the trust which owns Waverley, going to a new trust and then desperately needing a major refit. The Balmoral Fund are currently fundraising for an essential drydocking so the ship can return to service.

Waverley has had a slightly less chequered career, but has had extensive rebuilds and reboilering done in 2000 and 2019. One recent adventure was a collision with Brodick Pier, resulting on passengers being temporarily stranded on Arran in 2020. I hope my trip is a little less exciting!

Artie Moore

I don't know if someone at the BBC is reading Model Engineers' Workshop, but a week or two after our last issue appeared the story of Arthur Moore picking up signals from the Titanic reappeared on the BBC website. The story is at www.bbc.co.uk/news/uk-wales-65398807. The story's appearance may also be related to recent 3D images of the Titanic's wreckage. The article has excellent images of Artie, the Gelligroes Mill and his shed.

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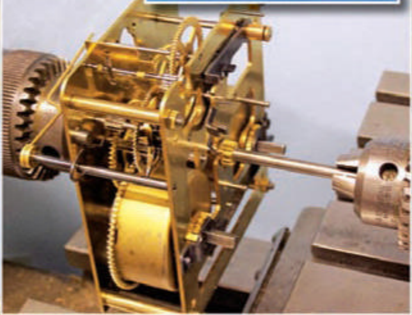

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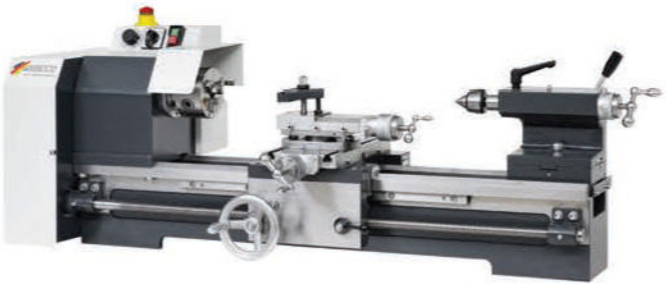

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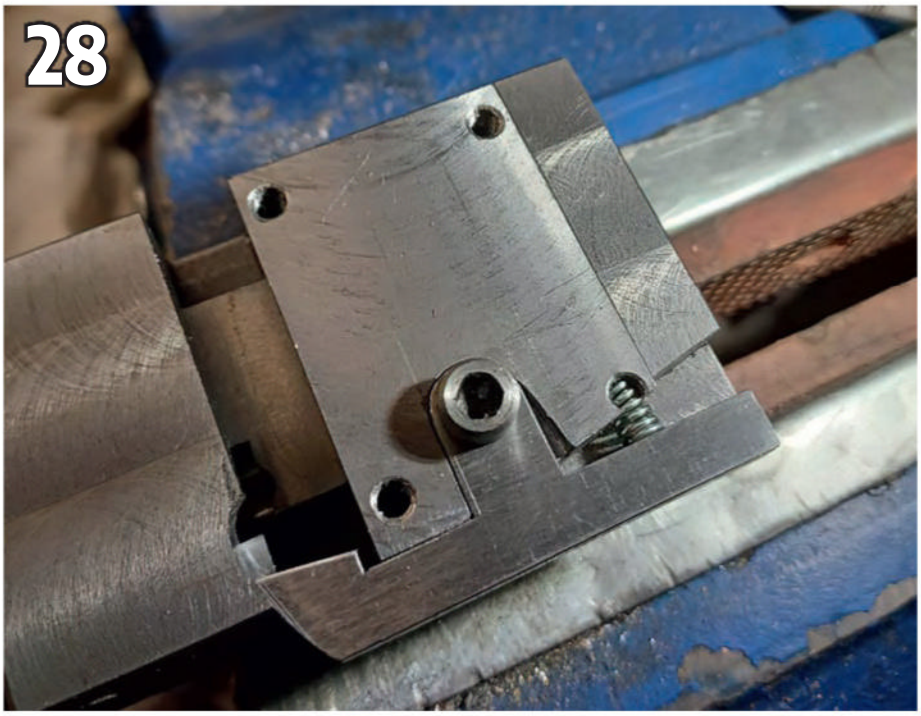

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John Our cover shows a 3D rendering of Paul Lousick's design for a compact belt grinder. For more details including plans, see pages 18 to 23. Full details on page 56.

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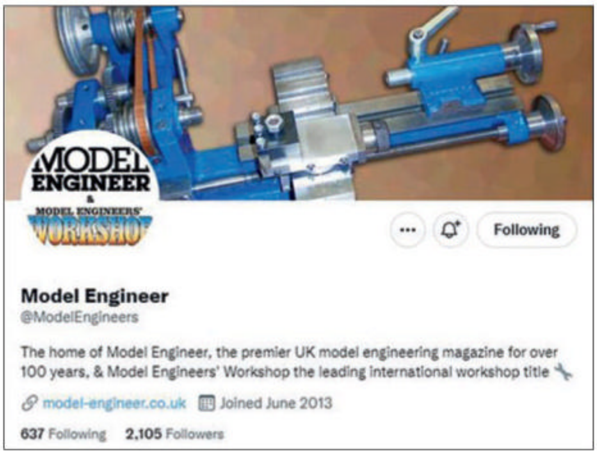

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THIS MONTH'S BONUS CONTENT

Log On to The Website for Extra Content:

Visit our website to enter our FREE competition to win a Clarke bench grinder.
www.model-engineer.co.uk/grinder

Other hot topics on the forum include:

Frozen Morse Taper Arbor Trouble freeing the arbor in a BF-25 milling machine By Trevor Gale

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Over-Engineered Workshop drawers A project designed specifically for welding education By Rooossone

Come and have a Chat!

As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. Come and join us – it's free to all readers!

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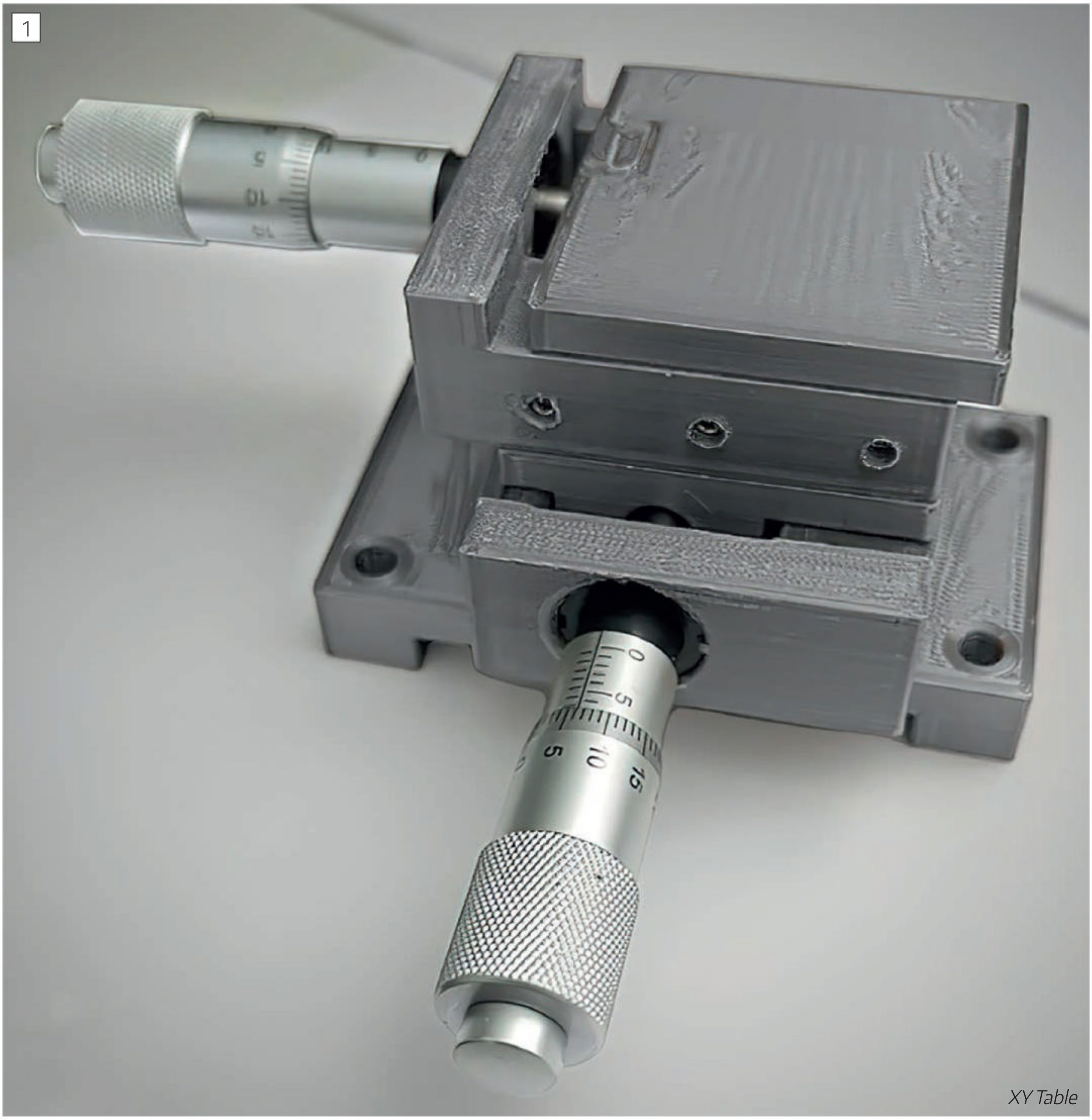
A 3D printed XY table

Adrian Rawson made a micrometer adjustable work table for a measuring microscope


1

XY Table

Having recently completed the construction of an electronic measuring microscope based on a Raspberry Pi coupled to an HQ camera, I realised how useful a small micrometer adjustable XY table would be to make 'accurate' measurements, **photo 1**.

I looked at buying one and found some nice examples for around £100. This led me on to thinking about making one out of steel or aluminium, more as an interesting project than a money saver. Whilst contemplating the design and the milling involved, I wondered if a

›

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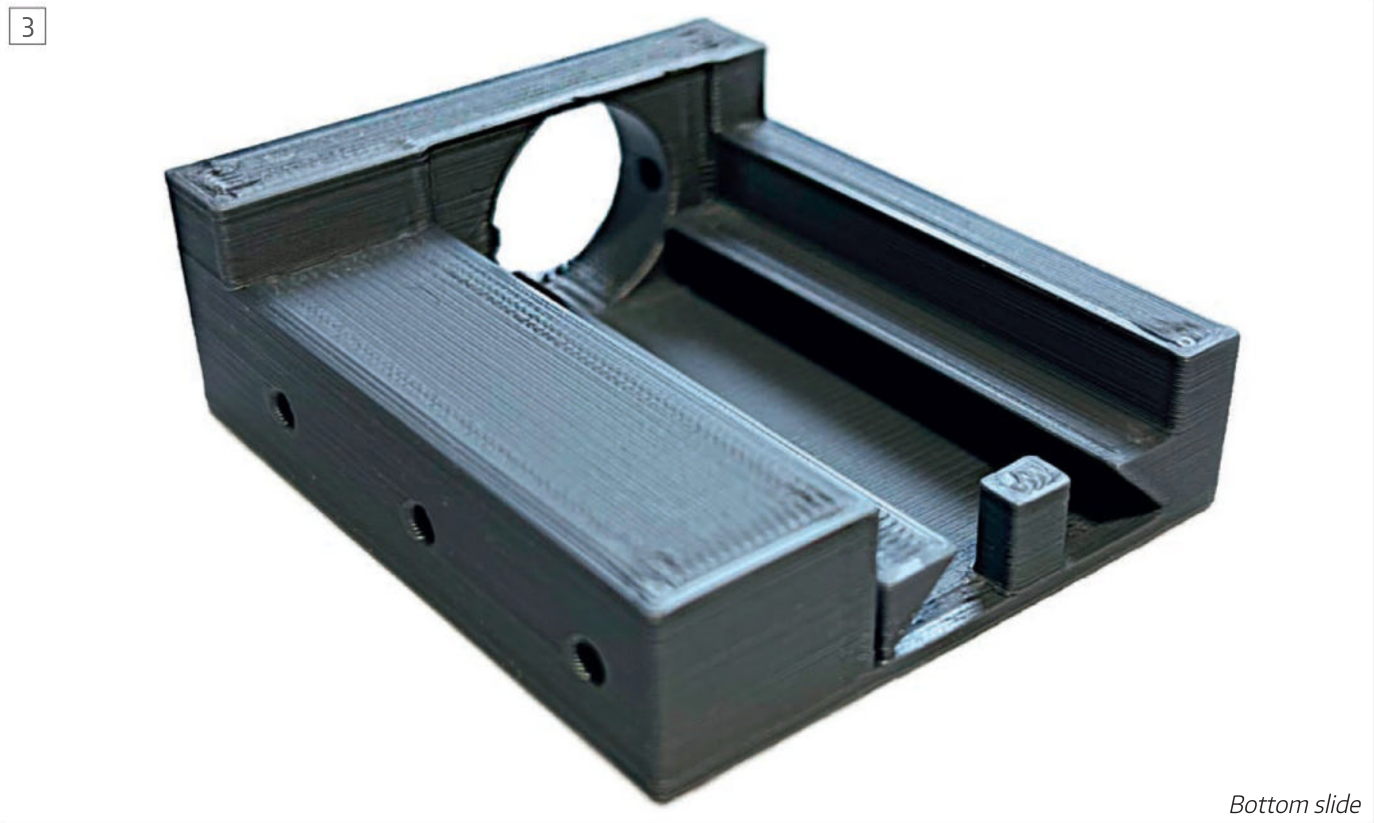
Micrometer Head

3



Bottom slide

satisfactory result might be achieved by 3D printing one in plastic.

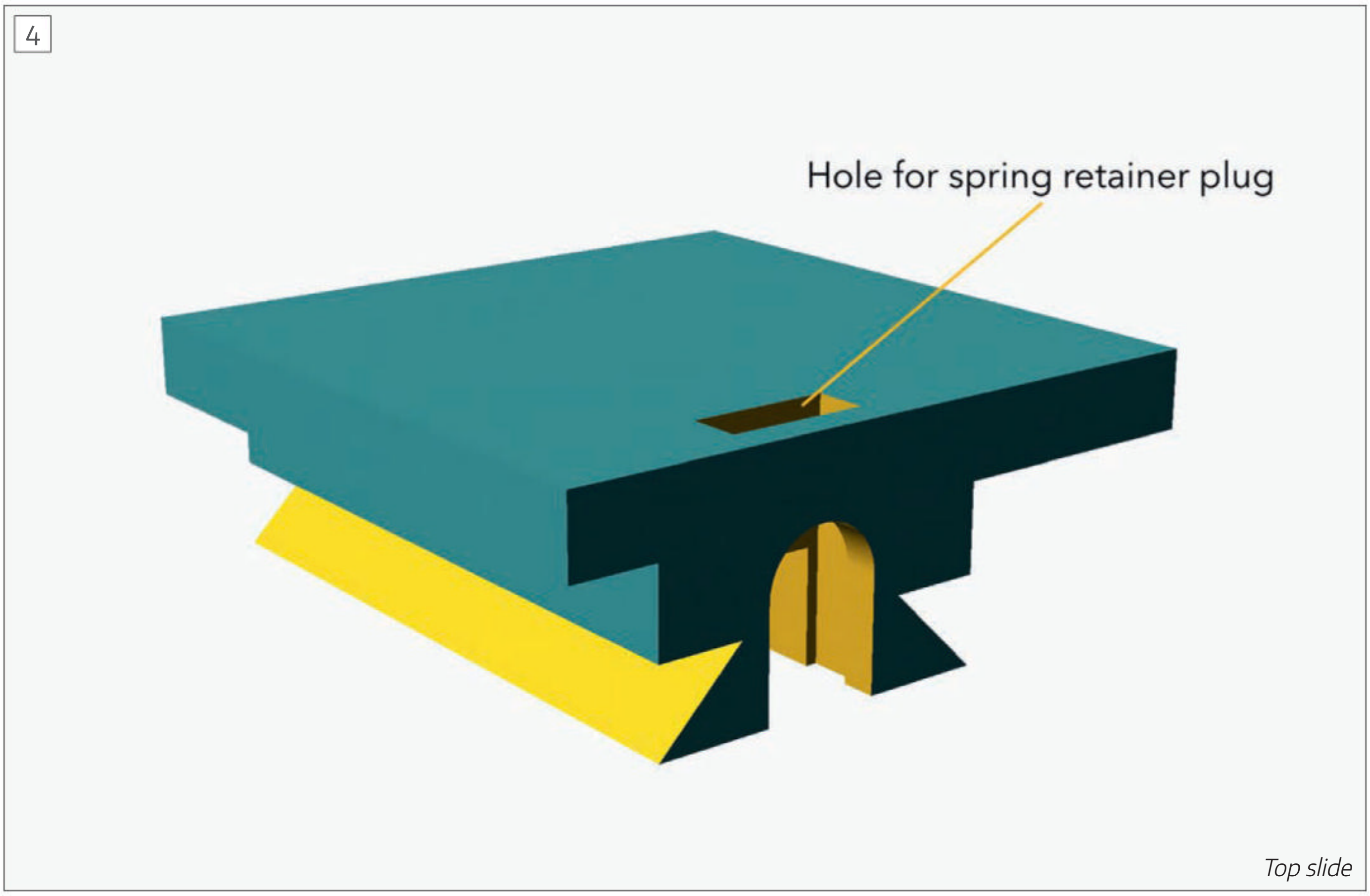
My first questions were, would the slides be smooth enough and how could I make them adjustable? My second concern was acquiring suitable micrometer heads that I could design around. After a bit of contemplation and a search on the internet, revealing some suitable 13mm micrometer screw heads for about £7 each, **photo 2**, I decided it was worth a shot.

The micrometer shown is graduated to 0.01mm but given other vagaries of the construction an accuracy of +/- 0.01mm should be achievable which in English is better than a thousandth of an inch, possibly not laboratory standard but good enough for a bit of horology.

Once the micrometer heads arrived, I took some measurements and set about creating a CAD design using OpenScad, which was used to render many of this article's images.

After a couple of false starts I came up with a slide adjustment mechanism based on a flexible dovetail and a spring

4



Top slide

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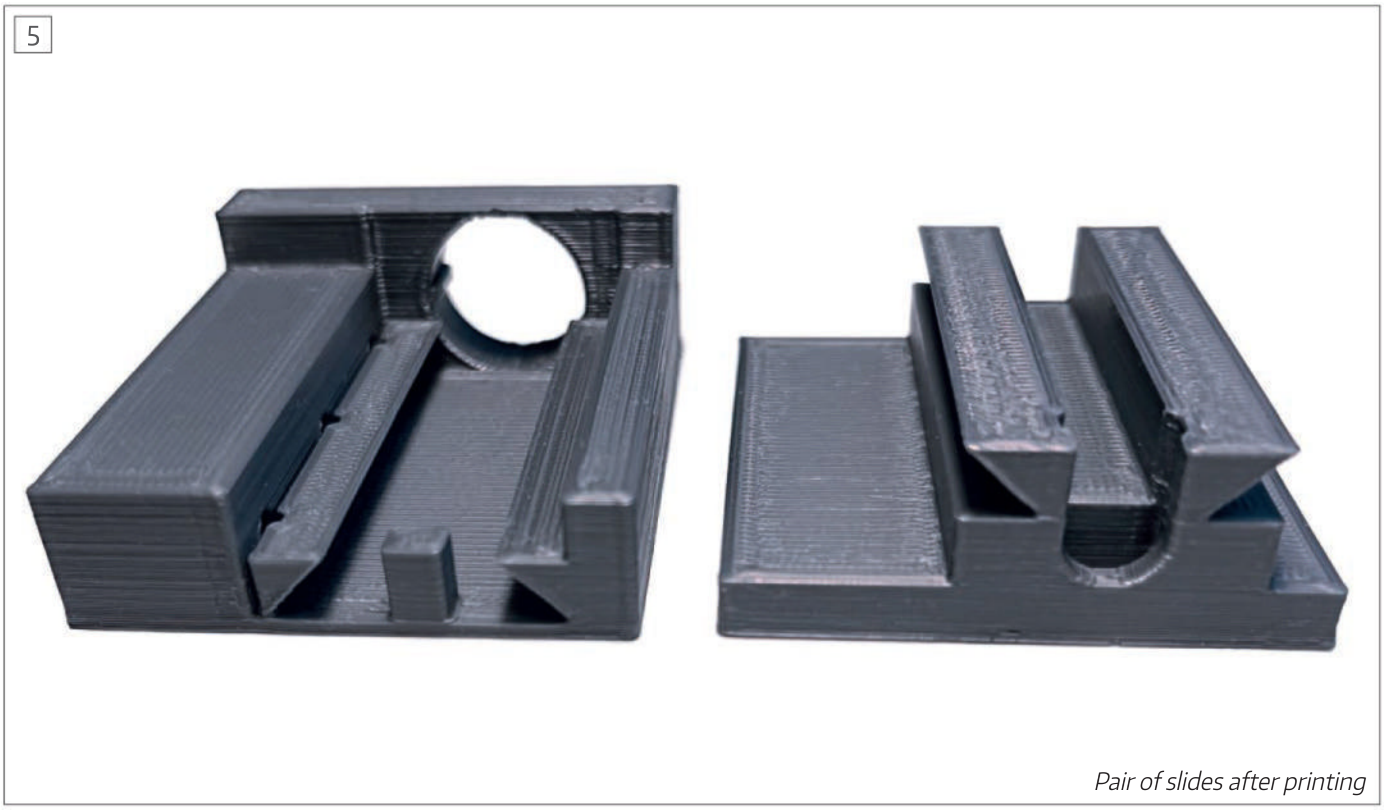


Pair of slides after printing

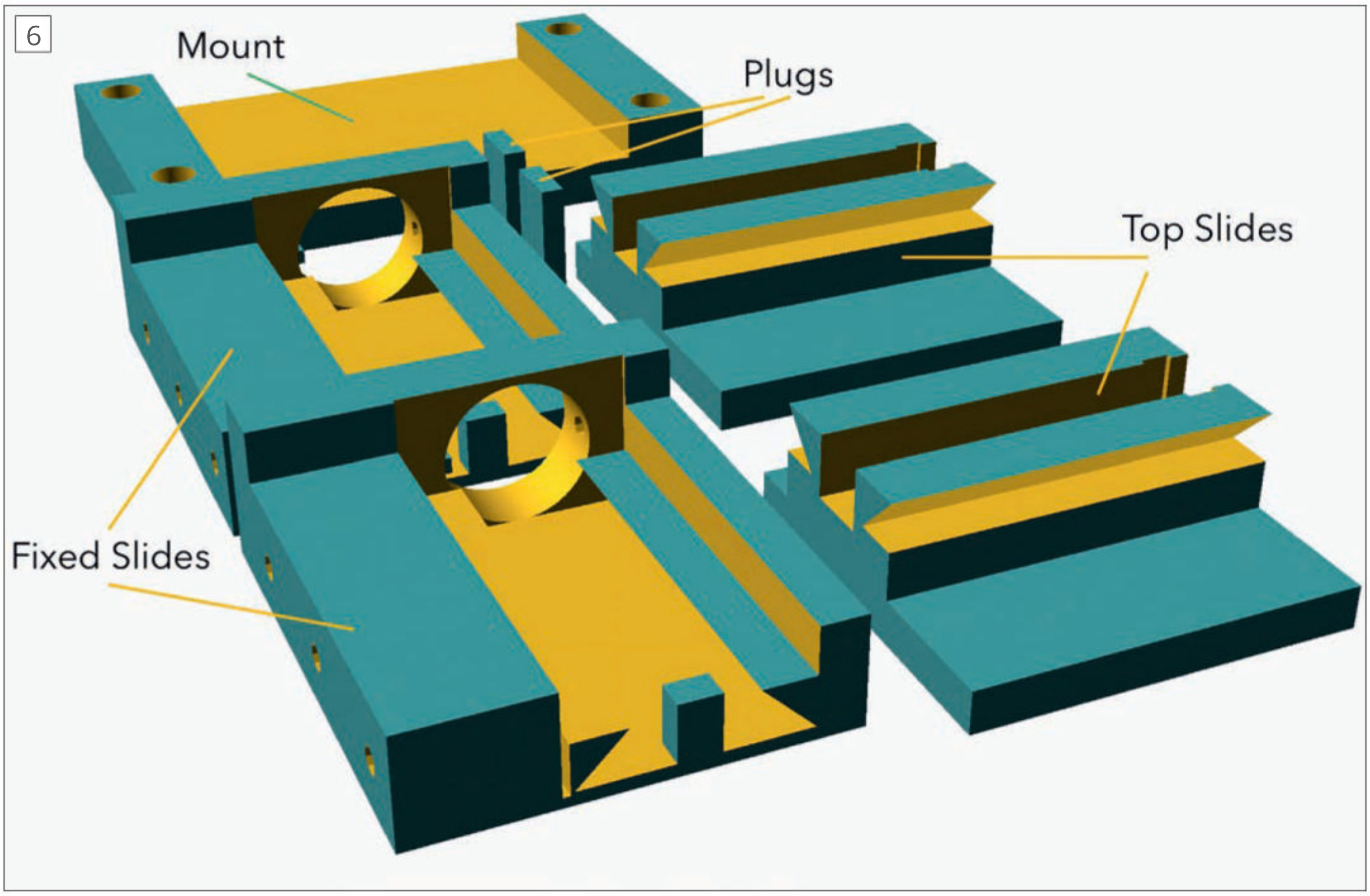
return which obviated the necessity to grip the micrometer heads plunger.

The bottom slide, **photo 3**, shows the flexible dovetail which is barely attached allowing it to be flexed inwards by the grub screws.

The top slide, **photo 4**, has a slot between the dovetails to accommodate the return spring and an insertable plug to retain the spring once assembled.

Photograph 5 shows a pair of slide components prior to assembly.

›


6

Full print layout

7
DRY PTFE
NSF H1
LUBRICANT AND
RELEASE AGENT
500ml

PTFE spray

Photograph 6 is a CAD render of the plastic parts required for construction. The orientation shown should print without the need for any support material. The secret is to use the finest slices that the printer will allow.

Once the components are printed the fit of the micrometers should be checked and the 14mm location holes cleaned up if necessary. In my case they were a snug fit straight off the printer.

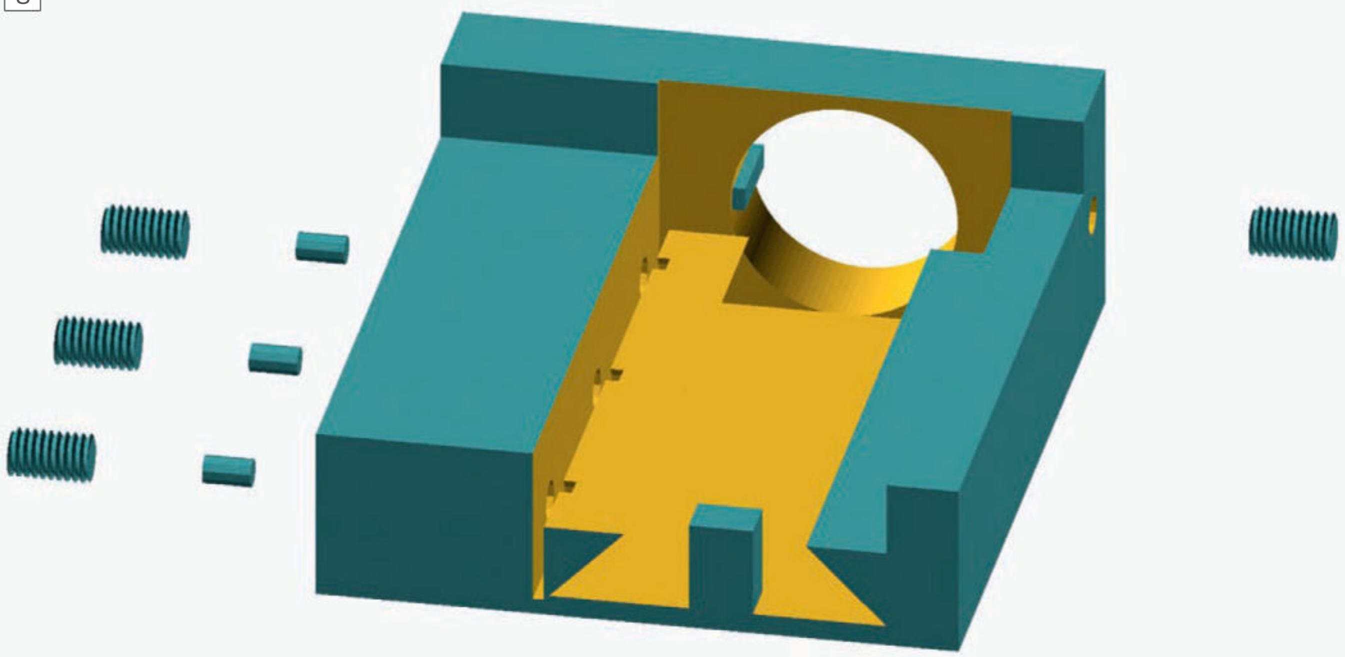
Now the slides can be checked for fit. If they don't slide together check for bits of spurious plastic and remove them. If they slide together completely with a bit of encouragement, then they should ease up after a few back-and-forth movements and become super smooth after a coat of PTFE spray, **photo 7**. This is magic stuff as it fills in the undulations in the plastic and leaves a coating of PTFE. Only spray the sliding surfaces as other surfaces will later be glued.

It's now a good time to tap the 3mm holes for the grub screws, **photo 8**. As I didn't have a plug tap available, I tapped the adjustment holes until the taps taper reached the flexible dovetail then filled the gaps with short plugs of 1.75 PLA plastic filament. This scheme worked well with the 5mm long grub screws I had available. The grub screw used as a retainer for the micrometer head can be tapped right through.

Provided everything slides freely it's time to fit the springs, **photo 9**. I used ballpoint pen springs, but the design allows for something a bit larger in diameter if necessary. The springs I used had to be stretched a bit to ensure sufficient travel. This is a bit fiddly, but the aim is to keep the table under tension once the spring retaining plug is in place. The spring retaining plugs, as printed, will most likely need a bit of filing to ensure a good friction fit.

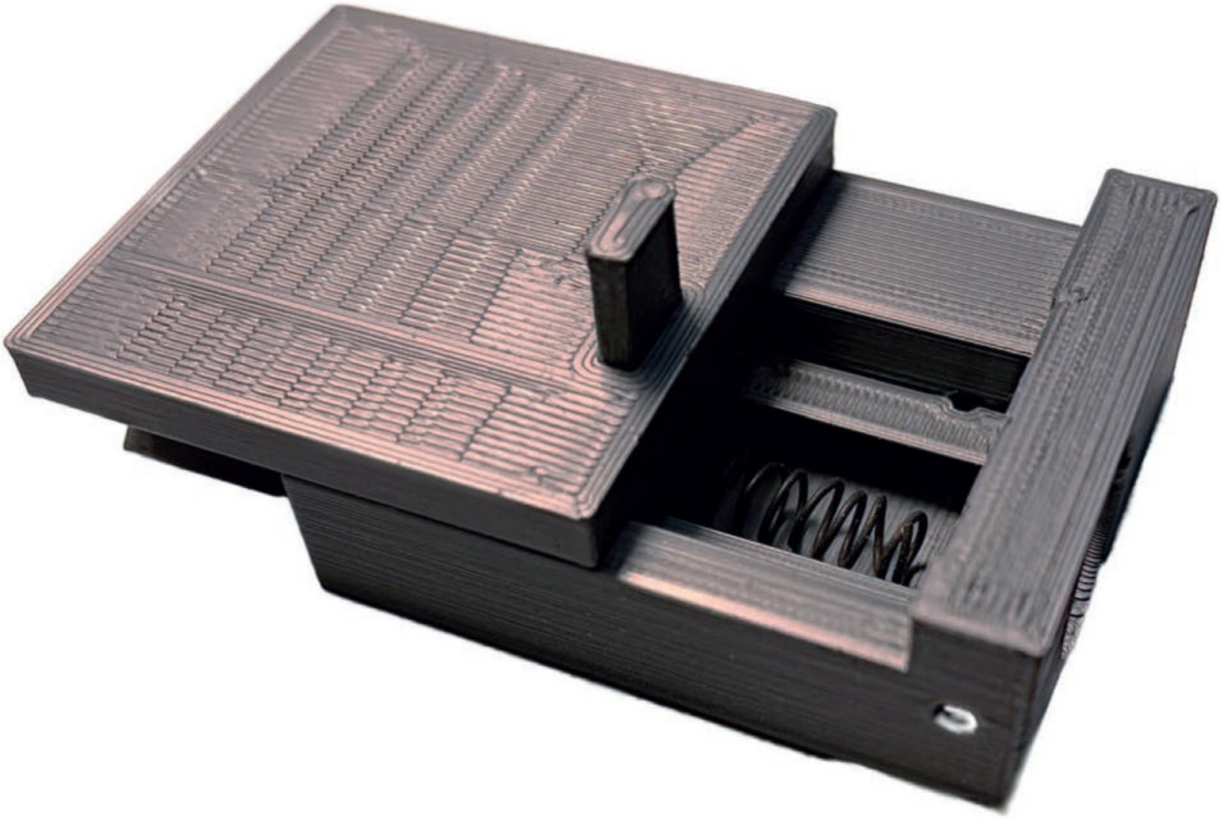
As the X and Y slides need to operate in their respective axes they must be stuck together at right-angles to each other. I was planning to use superglue but, in the end, used thin double sided tape which proved perfect for the job and offered the opportunity of disassembly should mistakes be made. Consider the final orientation of the micrometers when sticking the two slides together.

8



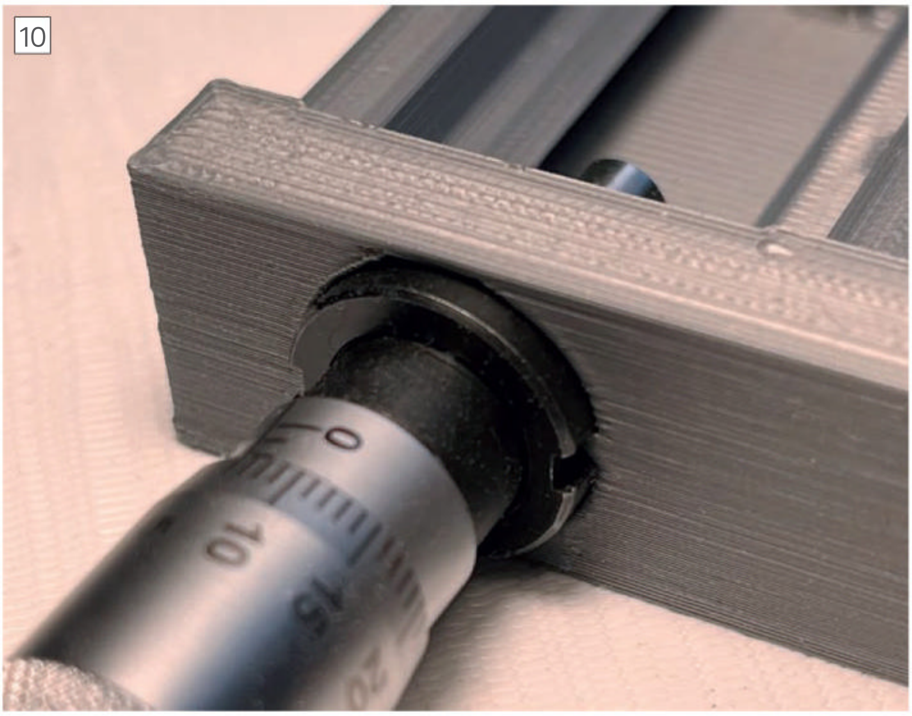
Grub screw locations

9



Spring location

10



Fixing Micrometer head

Now the slide assembly can be stuck to the base. Consider access to the mount's screw holes when completing this step. Fix the slide assembly off centre to satisfy this

Finally the micrometers can be attached. The design accommodates the notched mounting ring that came with the micrometers. There is a printed location point at one side of the mounting hole. The other notch accepts the grub screw, **photo 10**.

To tune out any sideways deflection in the X and Y tables adjust the grub screws Cut some pieces of PLA filament about 4mm long and drop them in the three adjustment holes on the fixed slides. Now insert the grub screws and wind them in until resistance is felt. Whilst moving the top slide back and forth tighten the grub screws one at a time until the slide starts to bind (don't over tighten as this may strip the plastic thread), then back off ensuring that it continues to move freely under the tension of the return spring.

The return spring's stiffness and length will tend to govern the optimum travel of the table, but if this centres on the half way point (6.5mm) it should prove satisfactory.

I have used the table to measure various sub millimetre items and it has proven its worth, particularly considering its low cost.

The STL files required for construction are available for download on my web site www.ahrprojects.co.uk. ∎

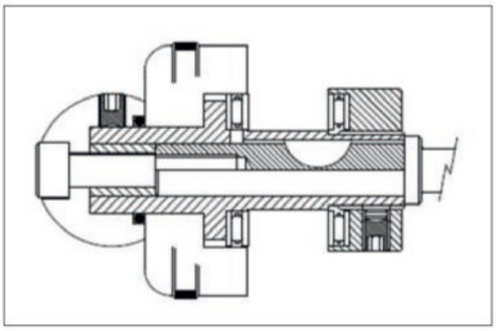
In our Next Issue

Coming up in issue 330, August 2023

On sale 21 July 2023

Contents subject to change

Andrew Johnston and his Adcock and Shipley milling machine



Graham Meek describes his telescopic feedscrew for a Myford taper turning attachment.

Johannes Schiffnyckel restores a tool grinder.

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DON'T MISS THIS GREAT ISSUE-SEE PAGE 54-55 FOR OUR LATEST SUBSCRIPTION OFFER

Model Engineers' Workshop and Model Engineer at the Midlands Model Engineering Exhibition

Exciting news about the forthcoming exhibition at Warwickshire Event Centre in October.

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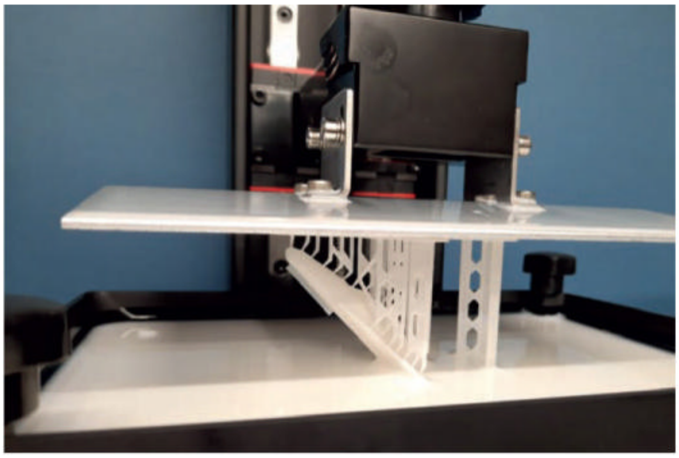


As regular readers will be aware, Model Engineers' Workshop and its sister publication Model Engineer are teaming up with the Society of Model and Experimental Engineers to celebrate our joint 125th birthday in 2023.

To mark the occasion we will be attending the Midlands Model Engineering Exhibition, organised by Meridienne Exhibitions.

SMEE Display

The SMEE will be having a super-sized stand featuring models And tools from across its history. They also plan to have live demonstrations of 3D printing by the editor of MEW, Neil Wyatt. These will happen on a daily basis so you will be able to drop into the stand during the day to see progress and also compare 3D prints produced in different materials and using different technologies. Examples are likely to include a 3D printed differential gearbox, scale models and workshop jigs and gadgets.

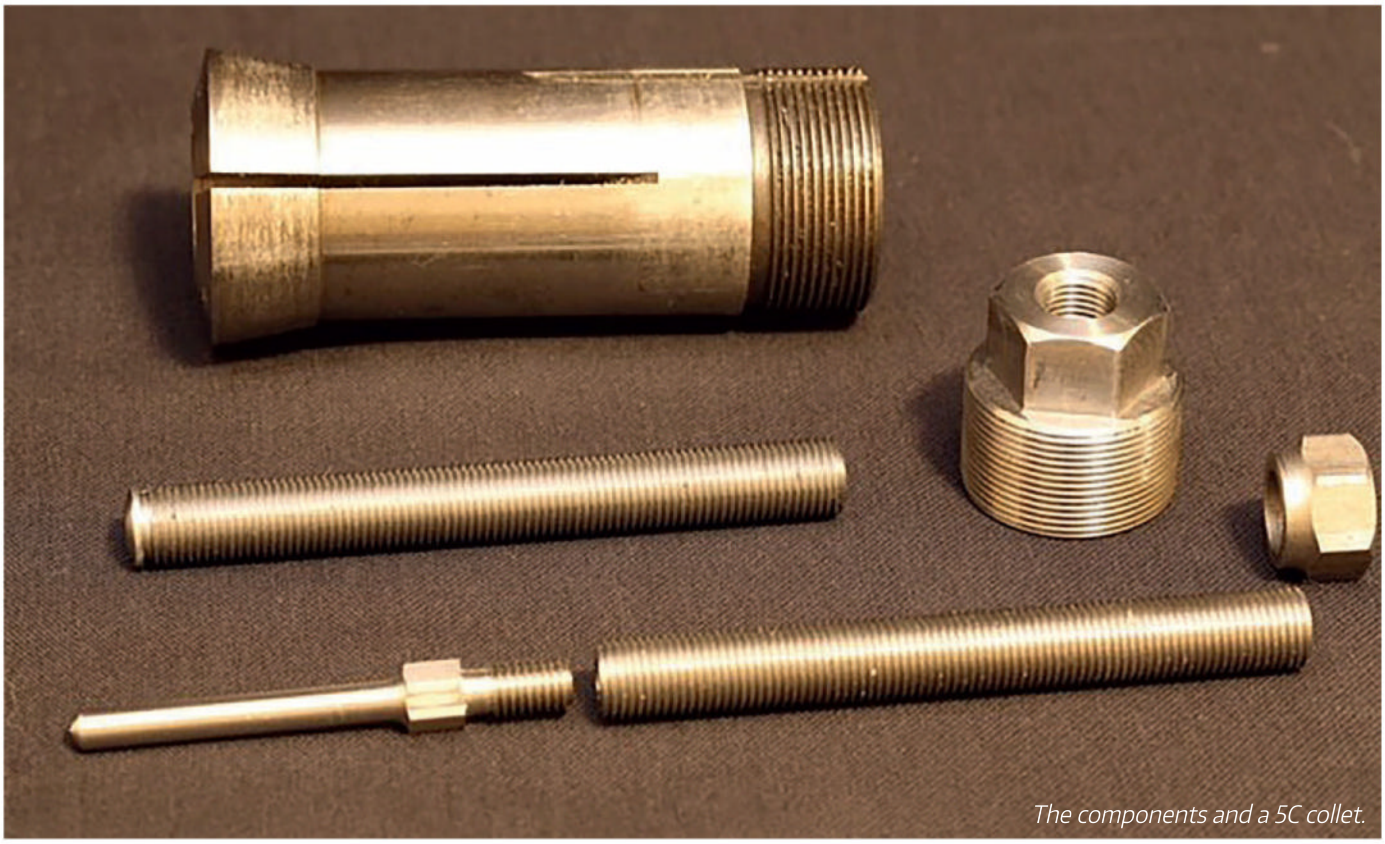
Magazine Talks

The magazines are organising a varied programme of illustrated talks. We have already confirmed the participation of several of your favourite contributors to the magazine, Expect subjects to be wide ranging, covering topics to appeal to readers of both MEW and ME.

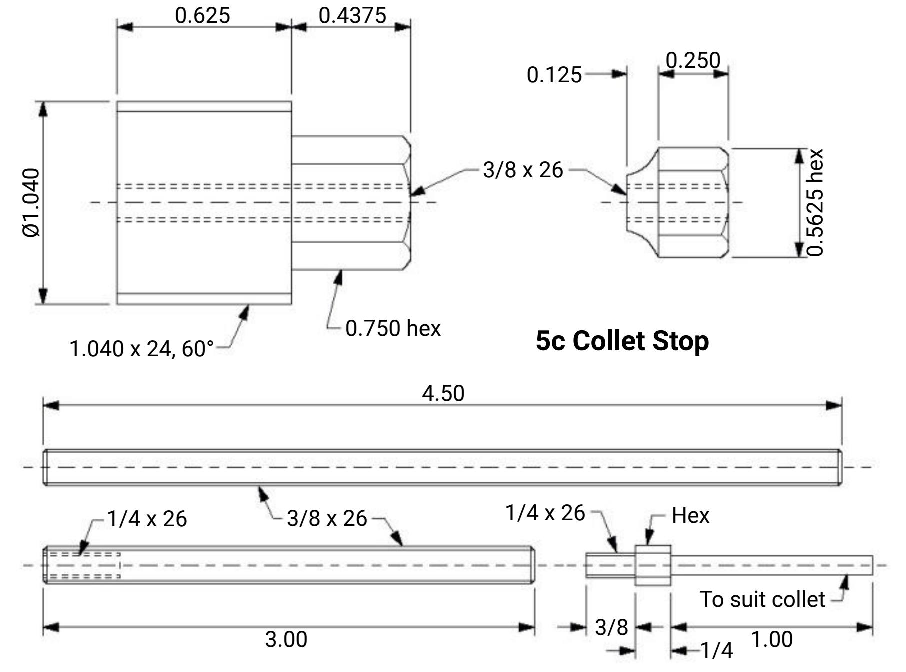
The details of the program are being confirmed in June so look out for an update in the next magazine.

A 5C Collet Stop

Bernard Towers little accessory for owners of 5C spin indexers will speed up a lot of jobs and improve accuracy.



The components and a 5C collet.



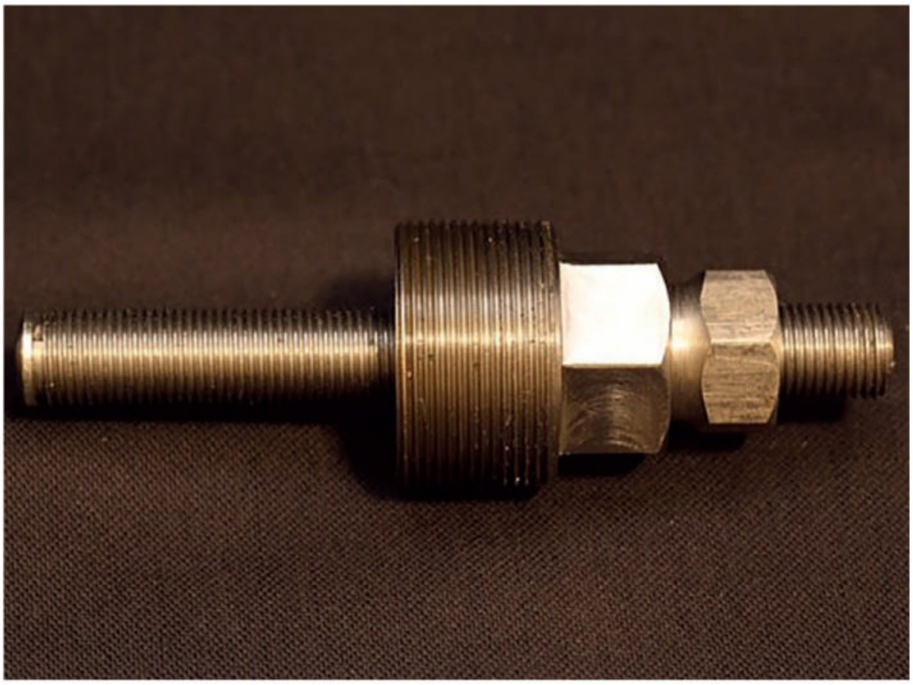
0.625
0.4375
0.125
0.250
Ø1.040
3/8 x 26
0.5625 hex
1.040 x 24, 60°
0.750 hex
5c Collet Stop
4.50
1/4 x 26
3/8 x 26
1/4 x 26
Hex
To suit collet
3.00
3/8
1/4
1.00

Figure 1

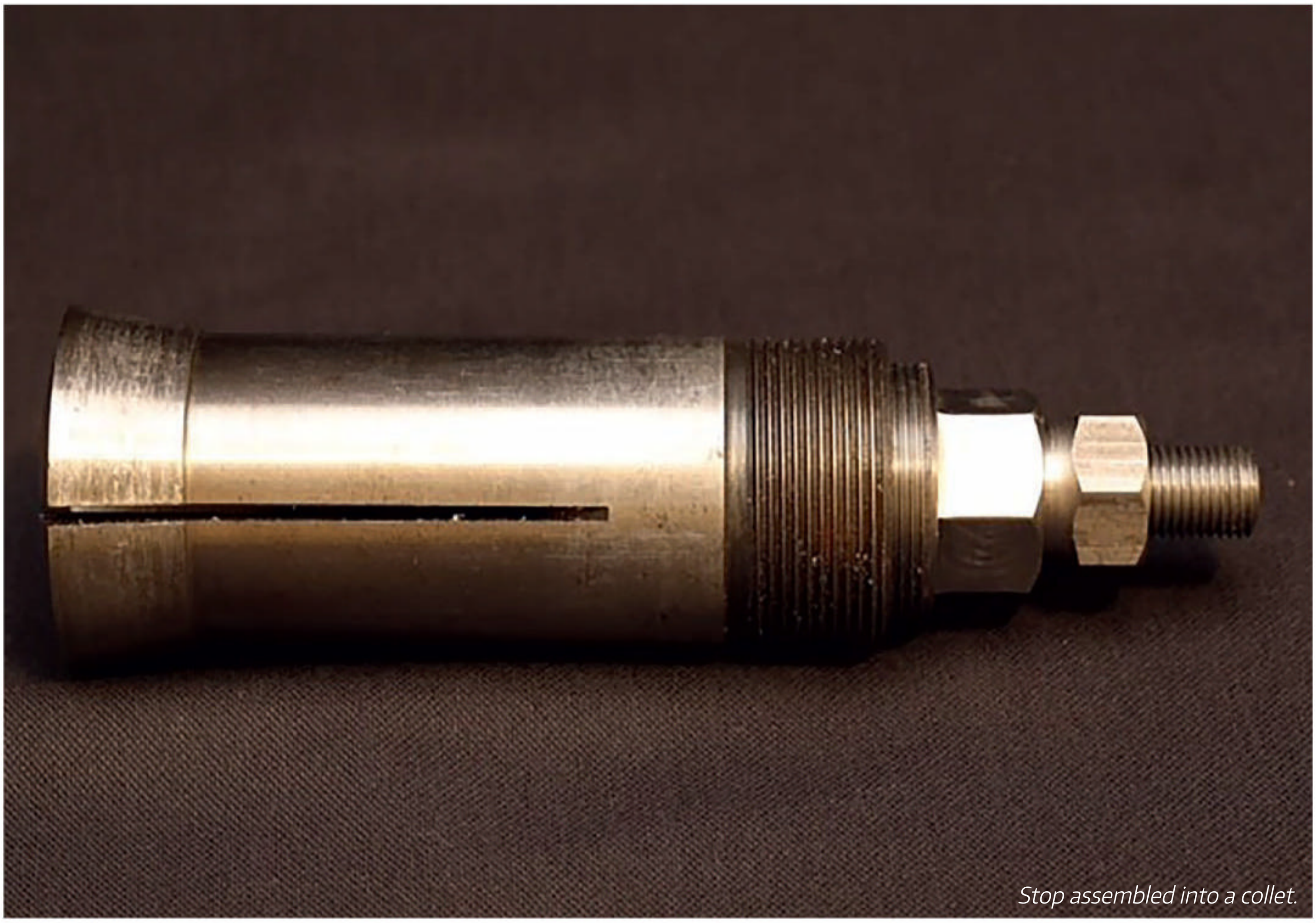
The ever-popular 5c spin indexer has been around a long while and has found good homes in many model /home engineers workshops. It has had many home brew modifications and improvements written about it in the past, but I have not seen a design for a collet stop for short workpieces.

By the way the 5c collet system is getting close to its 100th birthday!

With ten items to put hexagons on a part midway along each piece, a collet stop for the indexer seemed the way to go, **photo 1, fig. 1**. Alright I know they are quite cheap but there's something about using tools that you have made yourself and it's a nice quick job for a wet winter Sunday. Firstly, a piece is machined to 1.040" outside diameter and screw cut 24 tpi x 60 deg for 0.750" distance. Then drill and tap 3/8" or 10 mm x 1.0625" deep. Mill a hexagon 0.750" across flats, after 0.625" of thread and part off, then tidy up.


The completed stop.

Make up a threaded rod (good opportunity to practice your screwcutting), dome the end and slot the other end, **photo 2**. Also make one for collets smaller than 3/8"/10mm. The rod for the smaller sizes is just plain, threaded with a 1/4 x 26 internal thread one end, then pilot pieces of special sizes can be made up to suit particular jobs. Make a hex nut to suit the stud and you are good to go, **photo 3**. I bet they can't deliver one in the time it takes to make it!

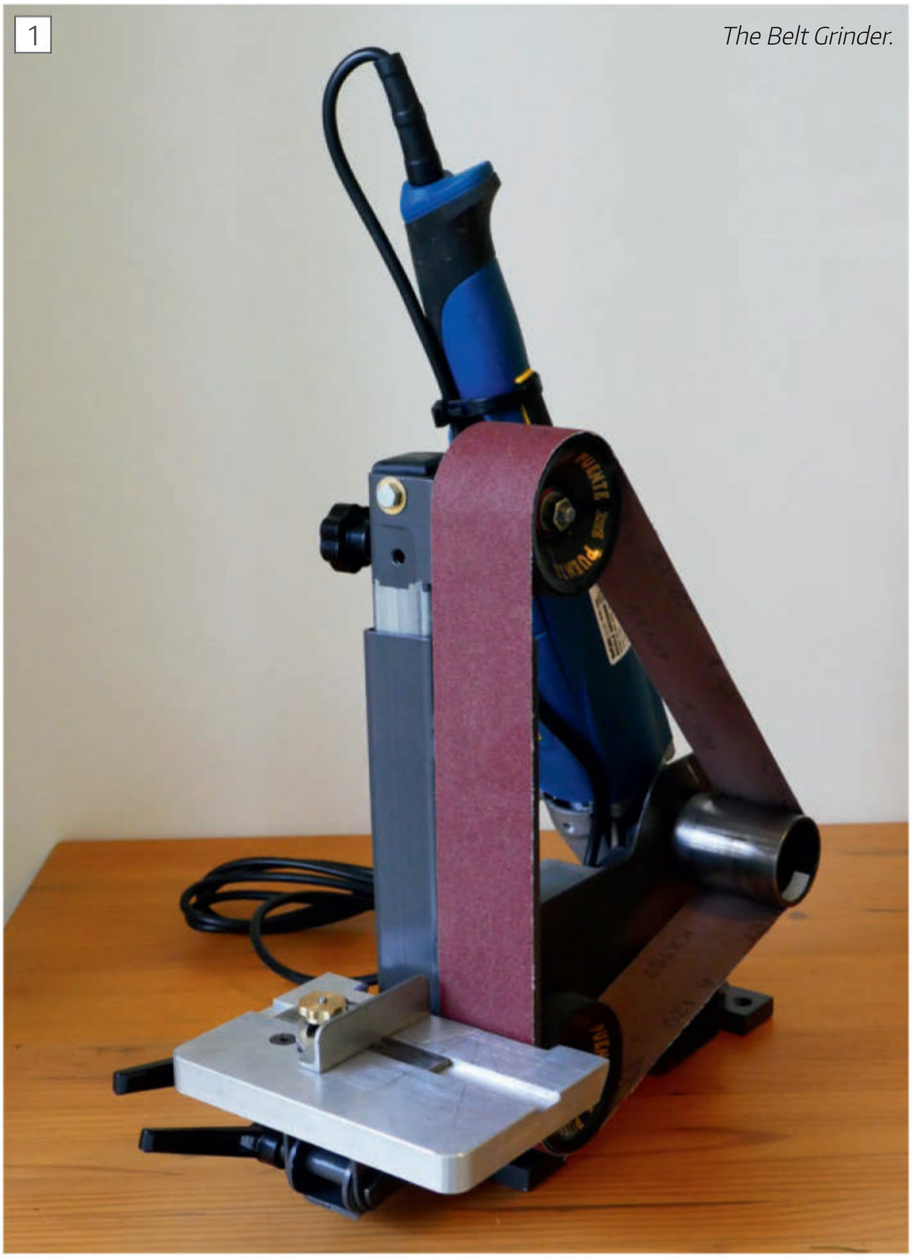

Stop assembled into a collet.

Universal Belt Grinder part 1

Paul Lousick describes his design for a compact belt linisher which uses a 4" angle grinder and can be used with either a 50 x 914mm abrasive belt or grinding wheels.

The 1200W angle grinder used was purchased from an ALDI store and is similar to those made by Ozito but has variable speeds from 4000–12000 rpm. (Slow speed for sanding wood and a higher speed for grinding metal).

The frame is fabricated from square steel tube (SHS) and uses skateboard wheels as belt rollers. A telescopic gas strut provides tension and easy replacement of the abrasive belt. Belt tracking is adjusted by a screw that tilts the top roller, **fig. 1, photo 1.**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The Belt Grinder.

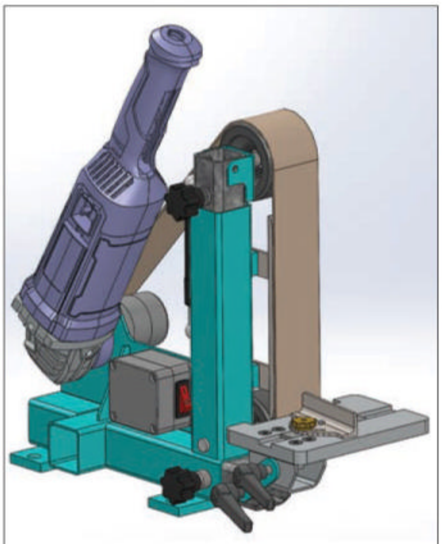


Figure 1.

Grinding disks/wheels can also be mounted directly to the angle grinder, but the speed used must be with the maximum permitted for any wheel. Shown here with a 100mm dia diamond cup wheel for sharpening carbide cutters. The adjustable support table can be used in either the front position with the belt or at the side with the grinding wheel, **fig. 2, photo 2**.

The finished components of the belt grinder were spray painted with an epoxy enamel. Zinc plated steel tube was chosen and left un-painted where they slide together. Parts of the grinder are shown in **photo 3**.

The main components of the base frame are fabricated from 40x40x2mm, square steel tube. The

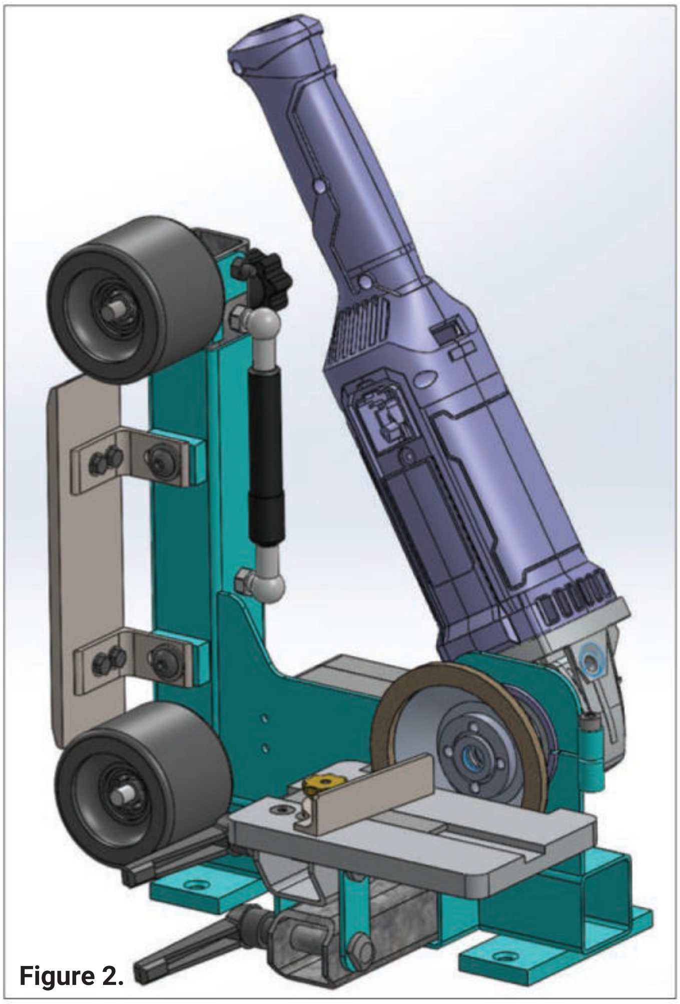
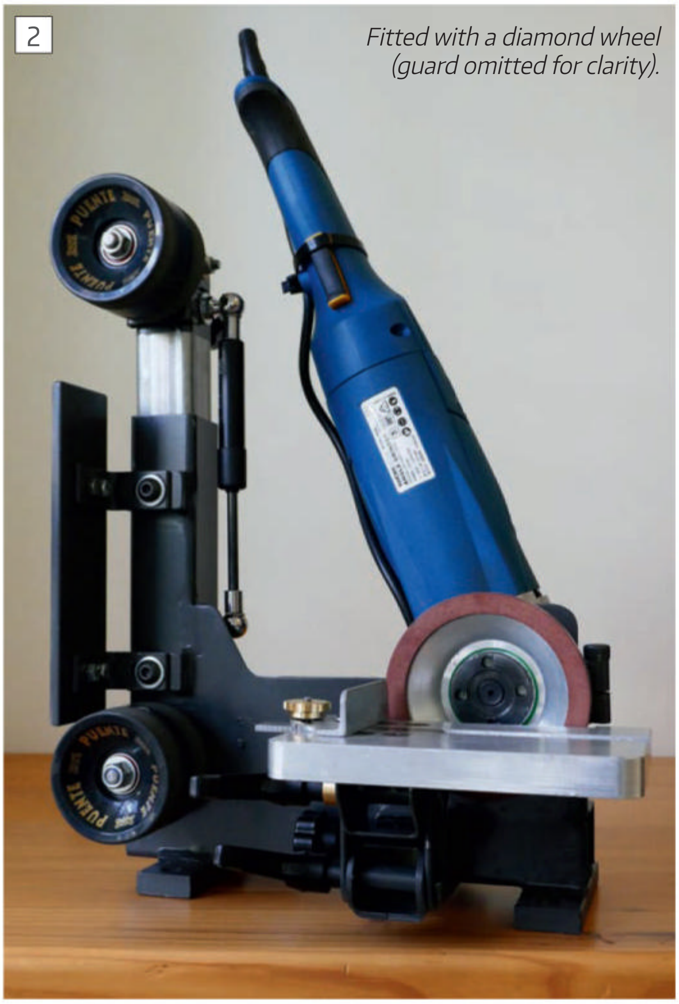
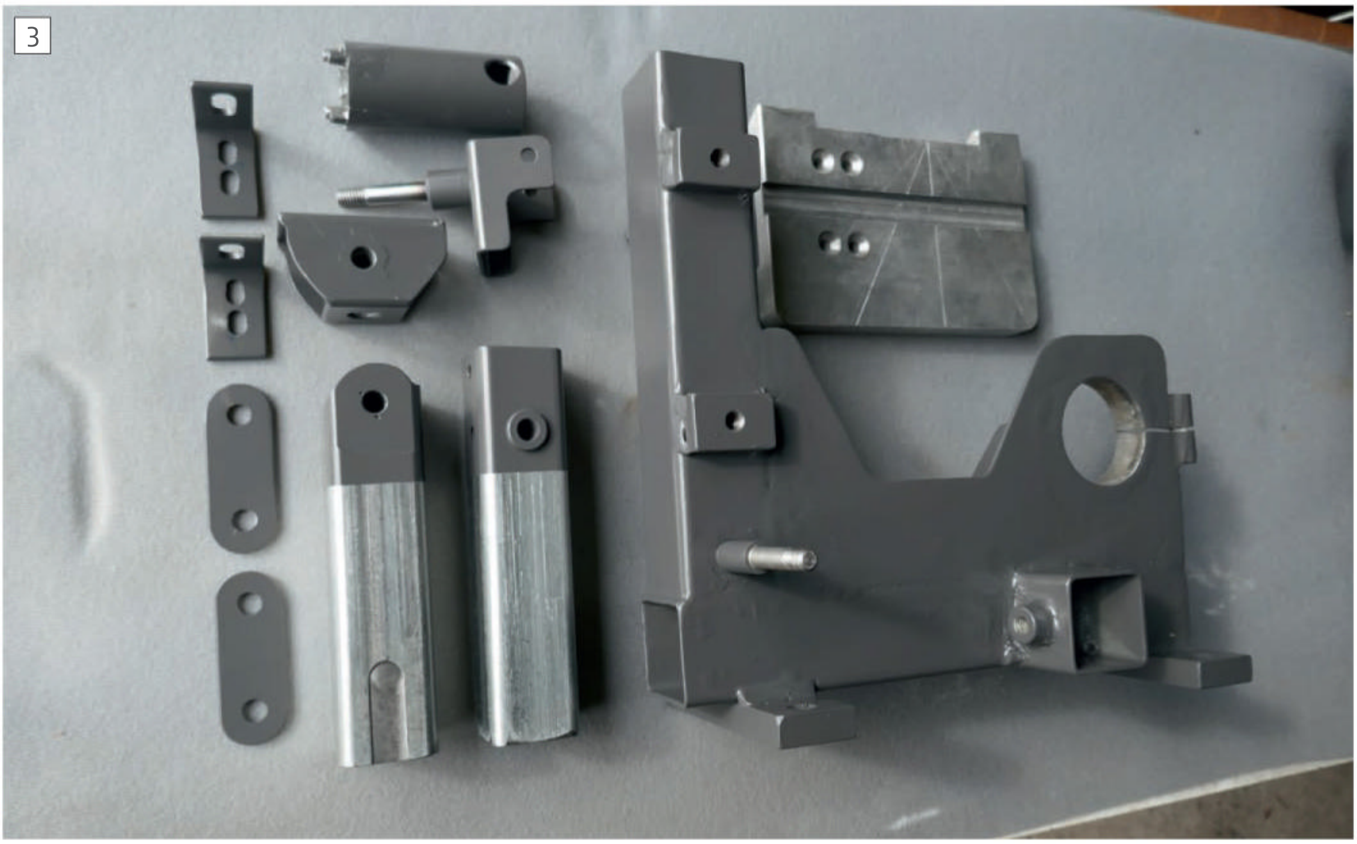


Figure 2.



2

Fitted with a diamond wheel (guard omitted for clarity).



3

Parts for the grinder.

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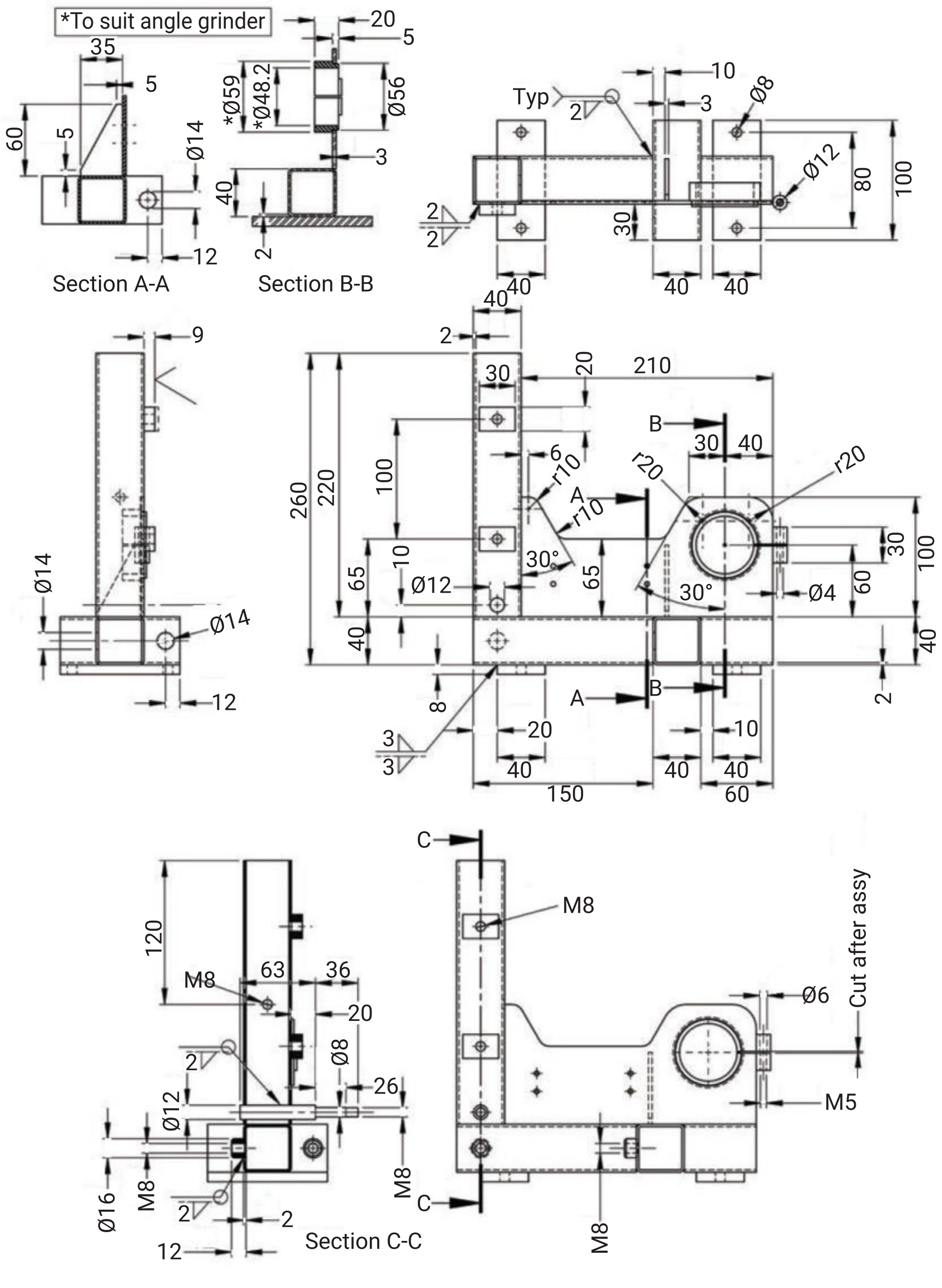
*To suit angle grinder
Section A-A
Section B-B
Section C-C
35
5
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Ø14
12
20
*Ø59
*Ø48.2
Ø56
40
3
2
Typ
10
Ø8
Ø12
80
100
30
9
210
B
A
r10
r20
30°
Ø4
Ø12
260
220
65
Ø14
150
60
C
M8
63
36
26
Ø16
Ø6
M5
Cut after assy

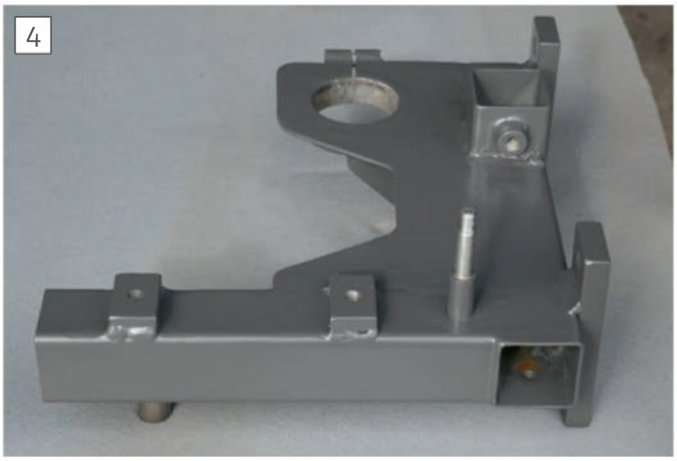
Figure 3.

weld bead on the inside of the tube has to be removed to allow the fitting of the sliding parts. I used a handheld grinder/linisher with a 12mm wide abrasive belt.

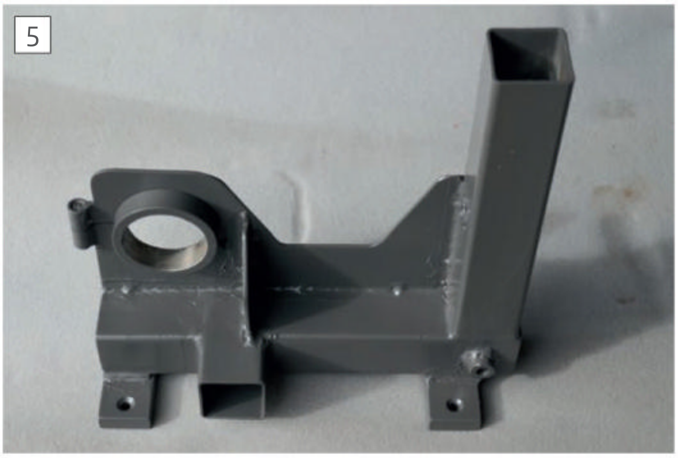
The feet were made thicker to allow the grinder to be bolted to the top of a bench for a permanent location or simply clamped in the jaws of a vice for temporary operation. Not all angle grinders are the same and the mounting boss should be modified to suit the angle grinder that you intend to use**, fig. 3**, **photos 4** and **5**.

Belt Tension and Tracking Assembly

The top roller assembly slides in the main frame and provides tension on the belt by a "Goliath" brand, 100N, 185mm long gas strut. Easy belt replacement is achieved by pressing down on the top



Base frame.



Another view of the base frame.

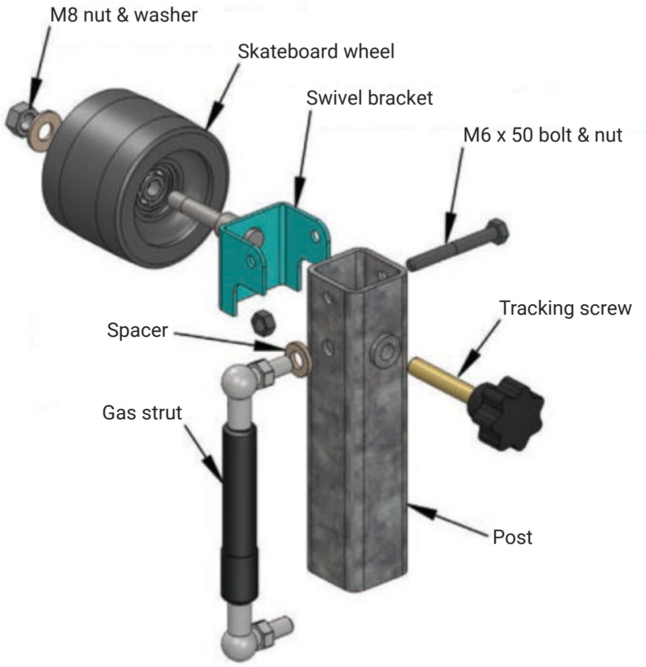

M8 nut & washer
Skateboard wheel
Swivel bracket
M6 x 50 bolt & nut
Tracking screw
Spacer
Gas strut
Post

Figure 4.

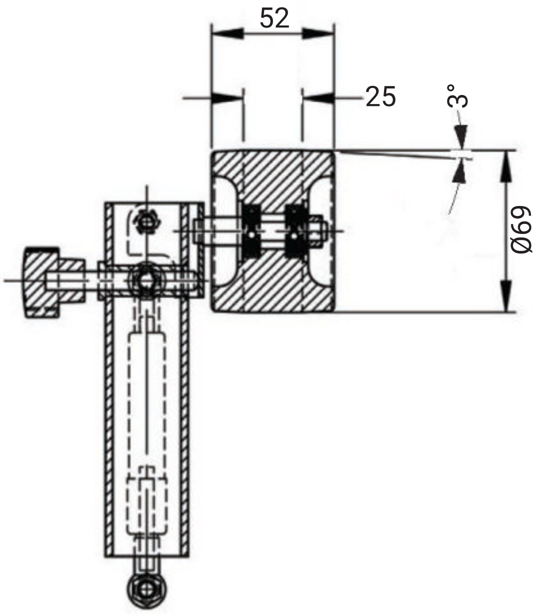


Figure 5.

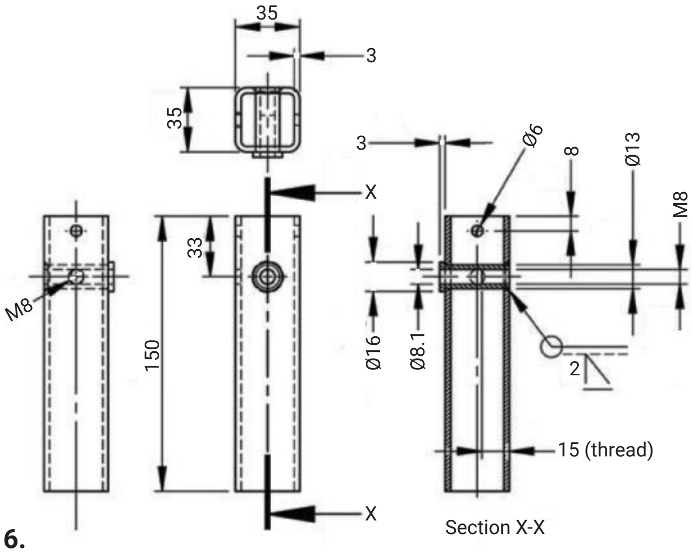

35
3
35
3
X
Ø6
8
Ø13
M8
33
M8
150
Ø16
Ø8.1
2
15 (thread)
X
Section X-X

Figure 6.

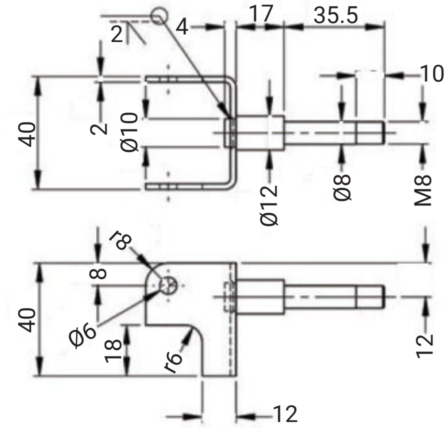
of the post to release the tension. The tracking screw swivels the roller wheel for aligning the belt, **fig. 4**.

The top roller is crowned by adding a 3 degree taper to both sides which will aid tracking and make the belt climb to the highest point when running. Skateboard wheel diameters may vary, **fig. 5**.

Belt Tensioner Post

Drill a 13mm dia. holes thru the 35x35x3 square tube as shown. Prepare a weld preparation countersink on the hole on one side only of the square tube. Turn the threaded insert for a slide fit into the hole and weld into position on the countersink side and machine flush, **fig. 6**.

›



2
4
17
35.5
10
40
2
Ø10
Ø12
Ø8
M8
r8
8
40
Ø6
18
r6
12
12

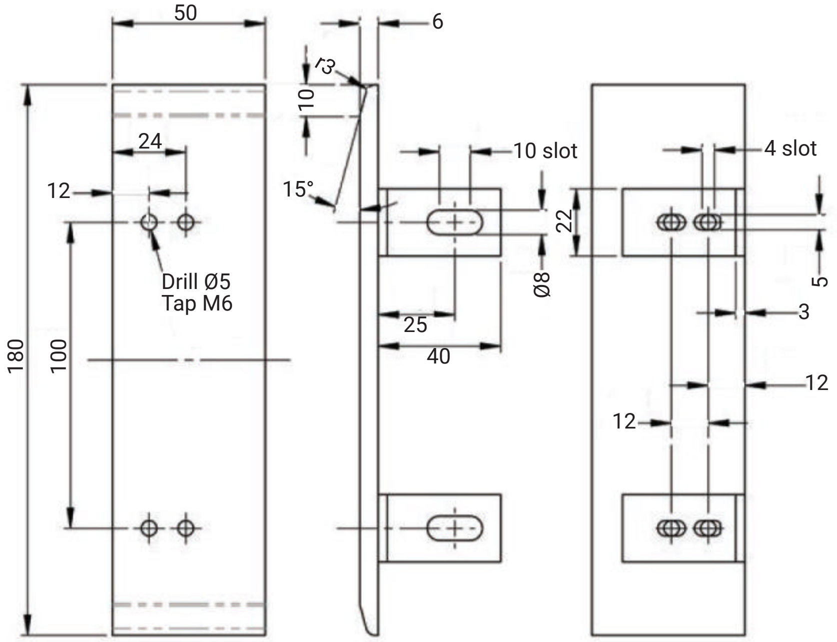
Figure 7.

Swivel Bracket and Axle

Cut the base from a piece of 40x40x2 SHS. Turn the stub axle and weld to the base. Check that your wheels are the same size and will suit the axle details on the drawing, **fig. 7**.

Belt Support Plate

This provides a backing support for the belt and is tapered and rounded at the ends to provide a smooth lead-in for the belt. The slotted holes allow for position adjustment with the belt, **fig. 8**.



50
6
r3
10
24
12
15°
10 slot
4 slot
22
Drill Ø5
Tap M6
Ø8
5
3
25
40
180
100
12
12

Figure 8.

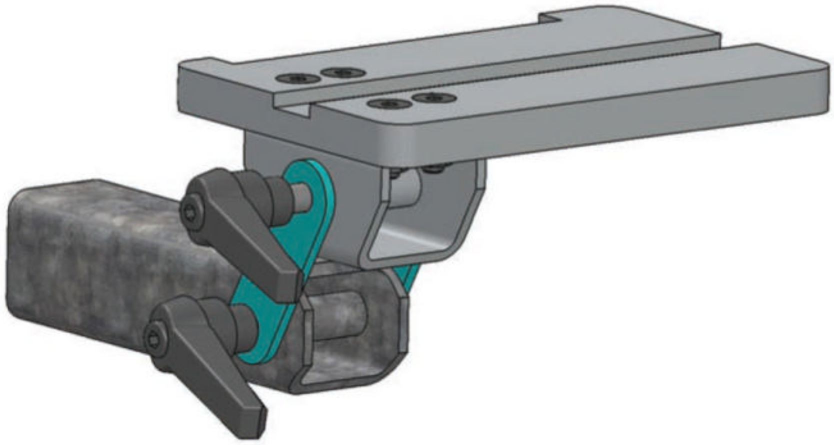


Figure 9.

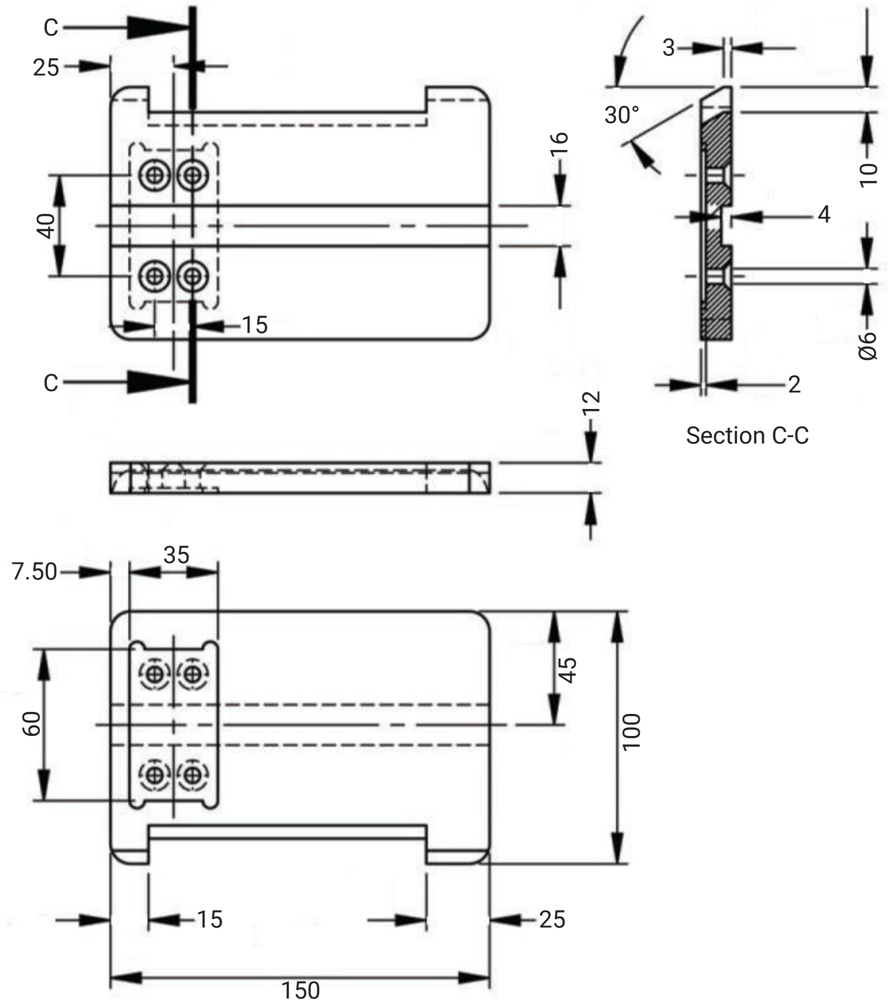
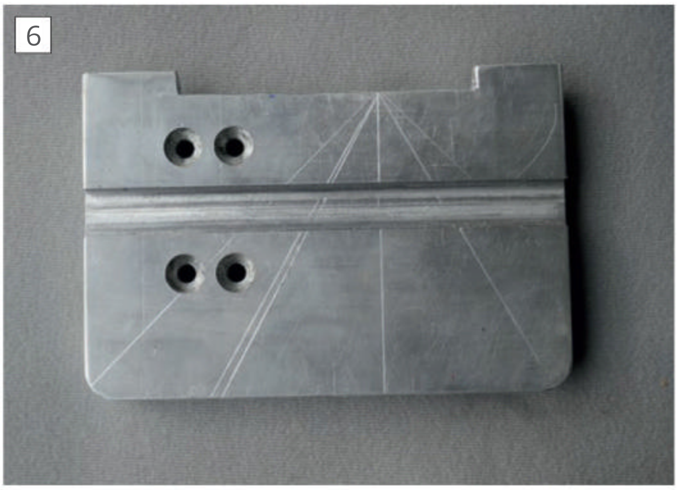


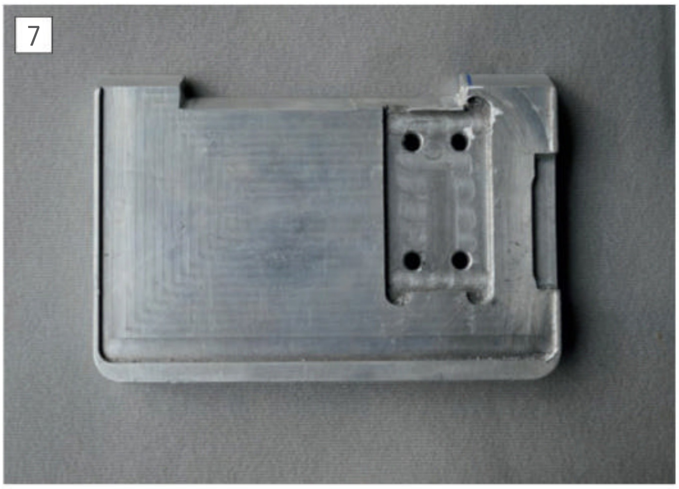
Figure 10.

6



Rest table with scribed lines.

7



Underside of the table.

Adjustable Grinding Rest

The rest can be raised, lowered and tilted by loosening the clamping nuts.

I have used ratchet nut handles, but threaded knobs or standard hexagon nuts could also be used, **fig. 9**.

The rest table was made from aluminium plate as I already had a suitable piece but it could also be made from other rigid material. A slot on the top surface is added for locating accessories. Optional lines can be scribed on the top surface (45º, 60º, 90º, etc.), **fig. 10, photos 6** and **7.**

● To be continued

BEGINNERS WORKSHOP
These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that may be out of date or describe practices or materials that we would not use today either because much better ways are available of for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practiced in the past.

Beginner's Workshop

By GEOMETER

GLANDS AND PIPE FITTINGS

A GLAND or stuffing box is the normal means of permitting reciprocation of a piston rod or plunger, or rotary motion of a shaft, at the same time preventing leakage of steam or water, oil, or whatever may be the fluid. Essentially, soft resilient packing is employed which will compress on adjustment and lightly grip the piston rod or plunger, eliminating leakage but not setting up undue friction.

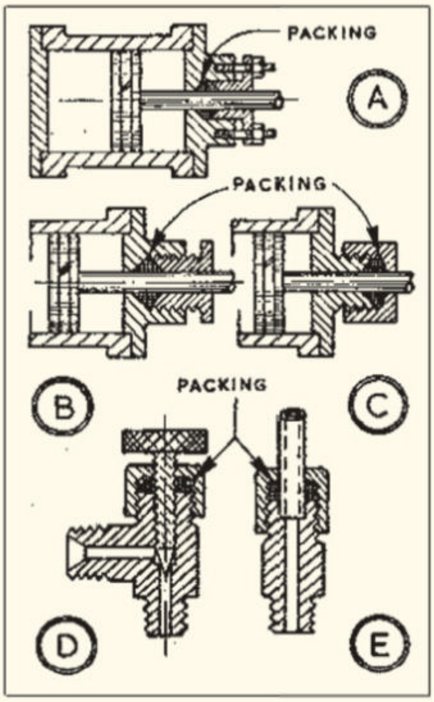
Too much reliance,. however, must not be placed on the inherent characteristic of a small degree of " take up," self-adjustment or compensation which a gland possesses. It is important for associated metal parts to be true and in good adjustment. In particular, portions of piston rods and plungers which actually work in glands should be smooth and parallel, for if the gland of a small engine has to be over-tightened to prevent leakage, power will be seriously diminished or the engine prevented from running. Repacking and adjusting a gland on a force pump (domestic type, for example) cannot long obviate leakage primarily caused by wear of plunger or piston rod.

Types and packing

Diagrams *A, B* and C show the main types of glands. That at *A* is the common oval-flanged pattern, adjusted by nuts on two studs and originally used for steam engines-possibly because the major work was plain turning, no threads being required other than those for the studs. In model sizes other than the smallest, construction is straightforward, but care is required to tighten the nuts evenly, maintaining the flange square and the piston rod free.

The gland at ***B*** utilises an internal thread and has a hexagon or slotted flange for adiusting. To avoid binding, thread and must be concentric-for which reason skill is required in making, especially in model sizes. In this respect, the gland at C is sometimes preferred, where the thread is external and a nut screws on.

Either glands B or C may be used on screw-down valves (domestic water taps), and small needle valves, *D*. In the latter connection, it can be said that the packing will compress and seal in the thread, as shown, providing it is true and smooth, and an important saving in length can be made, by comparison with valves having a plain diameter for the packing to bear on.



Most model and small commercial glands can be packed with soft asbestos string, loosened by untwisting, and made into strands of suitable size. Soft ordinary string or wool can also be used. The strands should be smeared with graphite or graphite grease for steam, and for water can be lubricated with water-resistant grease, and wound round the piston rod or plunger, in the direction in which a screw gland tightens.

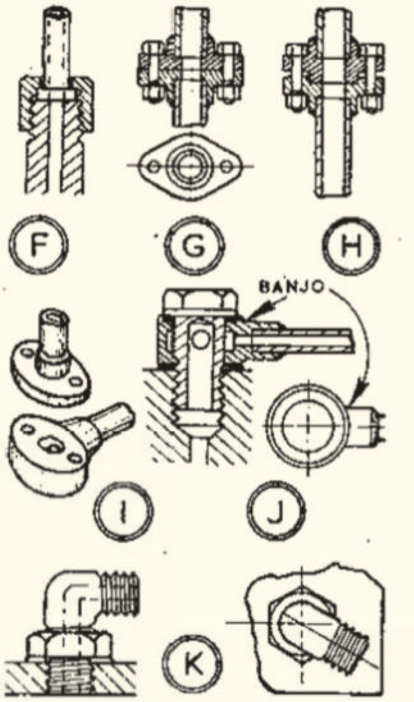
Pipe fittings

An adaptation of the external gland (C and *D*) is to a simple union fitting *E* which can be both smaller and shorter than an ordinary pattern. Unlubricated packing should be used and the nut screwed up tightly, particularly if there is pressure- though owing to possible blow out, the union is not really suitable for pressure. For this, a flange on the pipe *F* is desirable in conjunction with packing in the nut if required.

The normal pipe flange G is secured with two bolts, or by studs and nuts when fitted to a cylinder, and requires a jointing washer or gasket of paper or asbestos sheeting. Such a flange may be a plain oval brazed on the pipe, or have a small boss, as shown, mto which the pipe fits and is soldered.

A flange with a stepped seating *H* prevents jointing blow out, and in small sizes metal-to-metal connection can be made by lightly grinding the parts together.

Where a pipe needs to be at an angle, a special flange may be used Z or on a' cylinder or other casting a banjo fitting J employed or an elbow *K* screwed in and set as required with a lock-nut for connection by ordinary union. The banjo union,. it will be seen, has a circular sealing washer and bottom, an internal recess, and a hollow fixing screw drilled cross-wise to match with the recess. ❑



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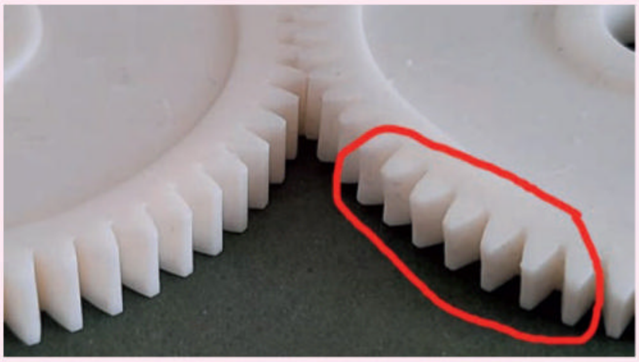
3D Resin Printer

Dear Neil, I enjoyed reading your article on the Creality Halot One Plus. Here is my question. Where is the distortion in the gear on the right and what extra support is shown for the gear on the left? Even under a magnifying glass, I could not discern the difference between the two gears shown in photo 23 (page 36 of article).

Joseph Sybille, by email.

Hi Joseph, Hopefully the enlarged picture makes this easier to see. The gear on the right has noticeably 'squished' teeth in the area circled, also the crown of the teeth is concave rather than flat. One consequence of the extra support (but hard to see) are small circular 'pimples' more evident on the gear at left.



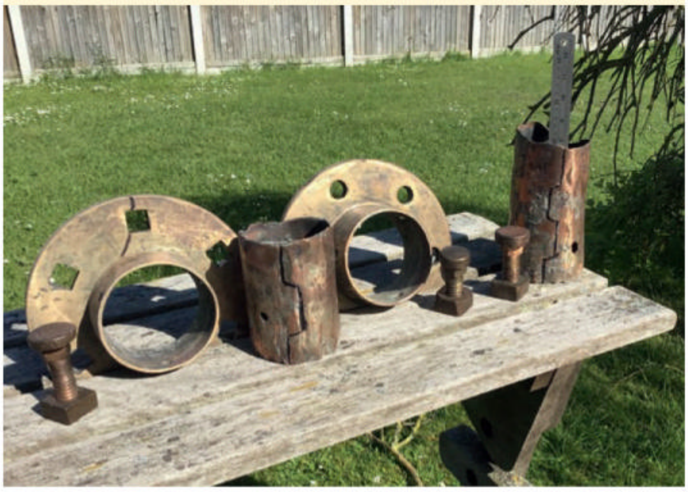
Mystery Flanges

Dear Neil.

Can anyone please shed light on the history of the pipe joint in the photo below?

The flanges are made of bronze, the pipes (4 inch ID) are copper, the joints in the pipe are dovetailed and appear to be braised; there are 6 bolts, all 3/4inch diameter, otherwise they have different threads, heads & nuts. The pipes were fixed in the flanges with a heavy lead collar. We were advised they could be part of a ship's steam engine or possibly part of a ship's water pumping system.

Brian Brown, by email



Delarge?

Dear Editor, in John Arrowsmith's report of the Harrogate Model Engineering exhibition in MEW issue 328, there are 2 mentions of a Delarge 15.S.8 GP car engine. I suspect this should be a Delage. Unless it's a very big one of course ;-)

Louis Delage founded the Delage company in 1905.

David Howse (reader since issue 1)

Thanks David, you weren't the only reader to spot the mistake, so did Tim Stevens. Delarge is also a French surname and not being familiar with the cars, I didn't register that it might be wrong.

Screw Manufacture

Dear Neil,

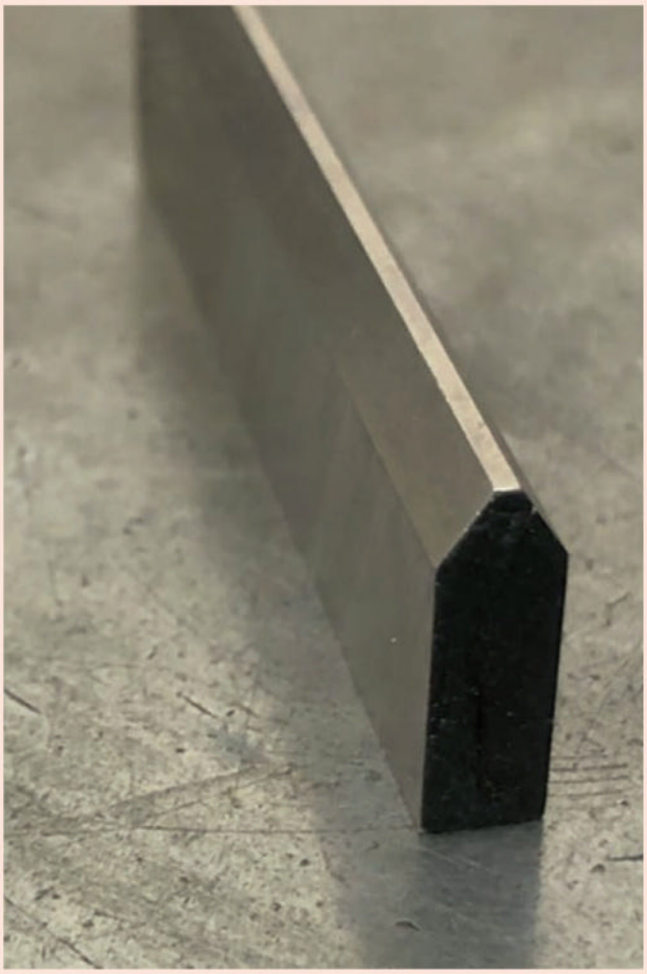
Way back in January, Sid Rawlings posted an enquiry on the manufacture of woodscrews and I assumed that my limited knowledge on the subject would be of little interest. However, I have seen no information forthcoming and thought the following may be helpful.

As an apprentice press toolmaker in the sixties I was employed by a manufacturer of brassware such as hinges, curtain rail, lamp holders, sail eyelets, etc. Manufacture was entirely self-contained; from a foundry, rolling mill and extrusion mill producing strip and bar for subsequent press and machining operations, to polishing, electroplating, packing and despatch. Scrap was returned to the foundry for reprocessing.

A number of products such as curtain rail, required accessory packs and these were also produced in-house, including woodscrews which were made in the 'Townsend Shop', so called because it housed the special purpose machines made by the Townsend Company, which I believe may have been American.

I was never directly involved in the manufacture of the woodscrews but my recollection is of a special purpose lathe which was hopper or magazine fed with headed screw blanks which were then screw cut by a form tool held in a tangential holder, making three passes in a deluge of cutting oil. The cuts would start at the head end with the tool holder moving away from the collet or chuck and travelling along a linear cam. This cam was contoured with an upturn which tipped the tool holder forward as it approached the free end of the blank to produce the pointed screw tip. The screws had parallel outside and core diameters apart from the pointed tip although a quick glance may give the impression that they were tapered.

The form tools for screw cutting were made from a very hard high speed steel known as Deloro Stellite and were made in the toolroom. They were about four inches long and, being tangential, only required the end to be ground when re-sharpening. Thus, they were long lasting and much prized by apprentices. I've attached a photo of the stub of one such 'trophy' which shows the thread form.



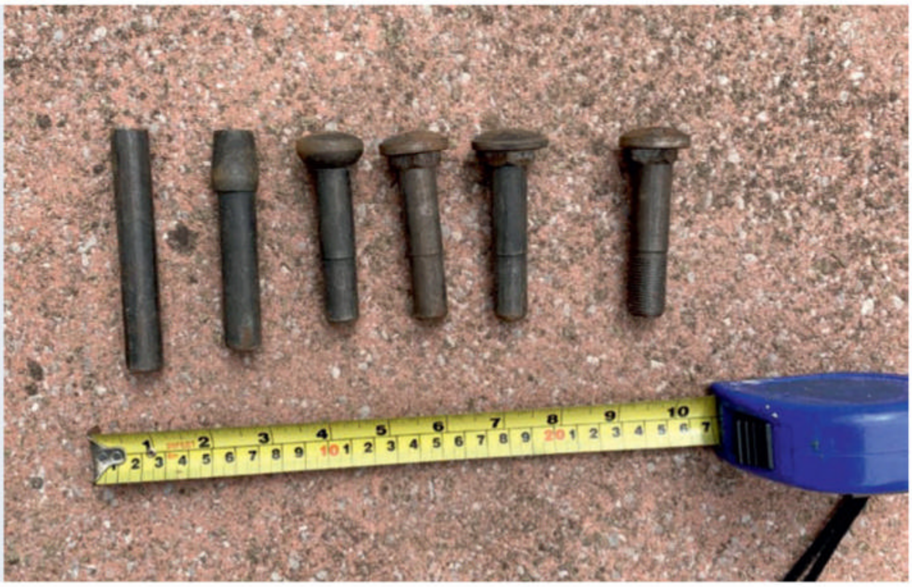
In the absence of anything better, I hope I have been able to help.

Graham Williams, by email

Bolt Manufacture

Dear Neil, further to your readers correspondence, perhaps some may be interested in the photographs of the various stages of manufacture in forming bolts from a piece cut from a coiled roll of steel to a finished bolt by use of several large high presses . Obviously different dies will produce different types of bolt.

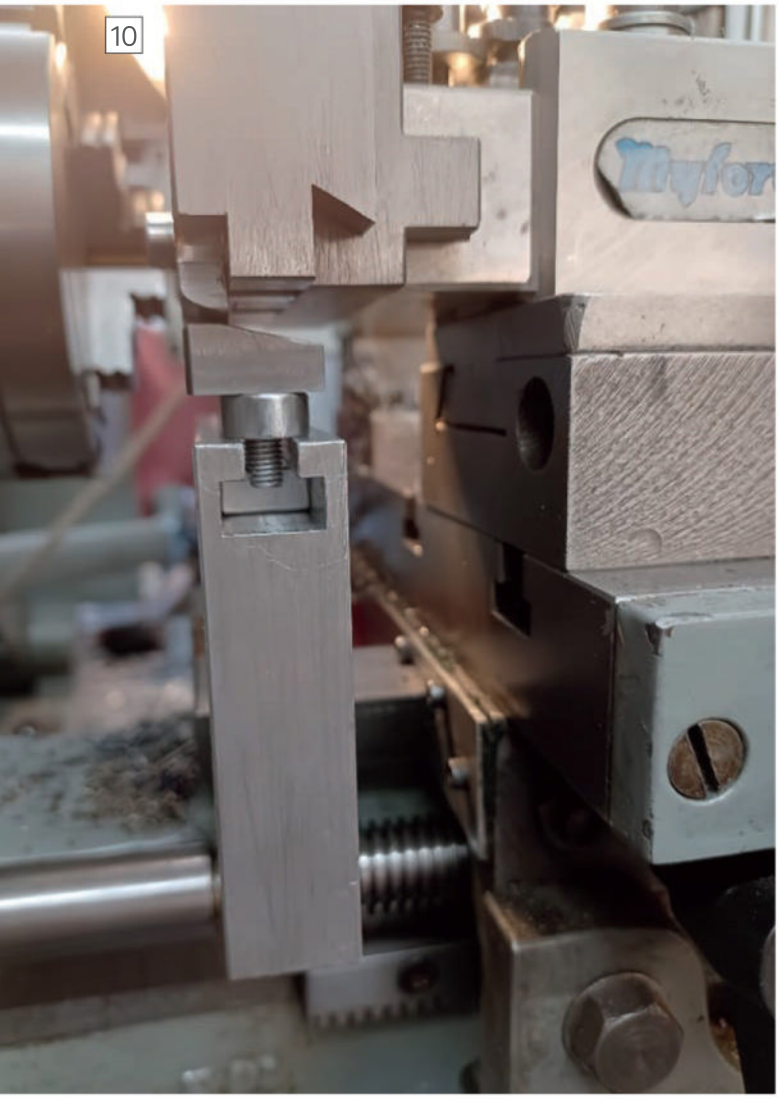
Kenny Mackenzie, by email.



A Retracting Toolholder For Screwcutting With A Twist

David George modifies a classic design by George H. Thomas for automatic operation. Part 2.

10



Clamp in t-slot.

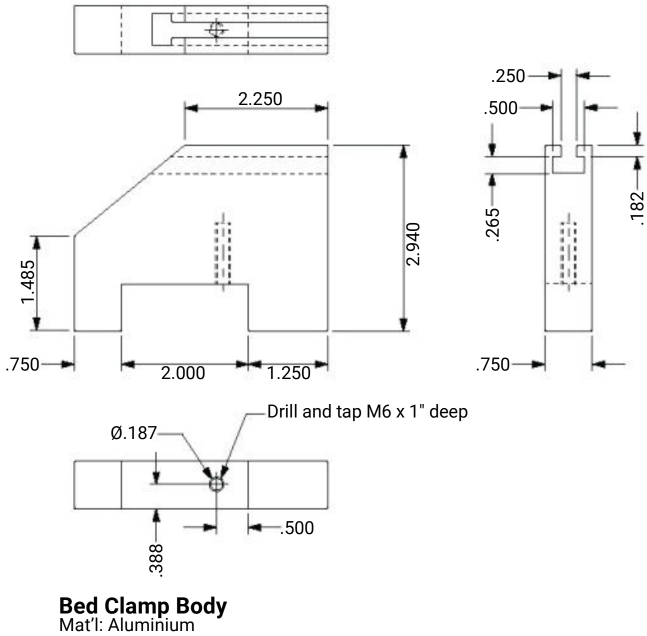
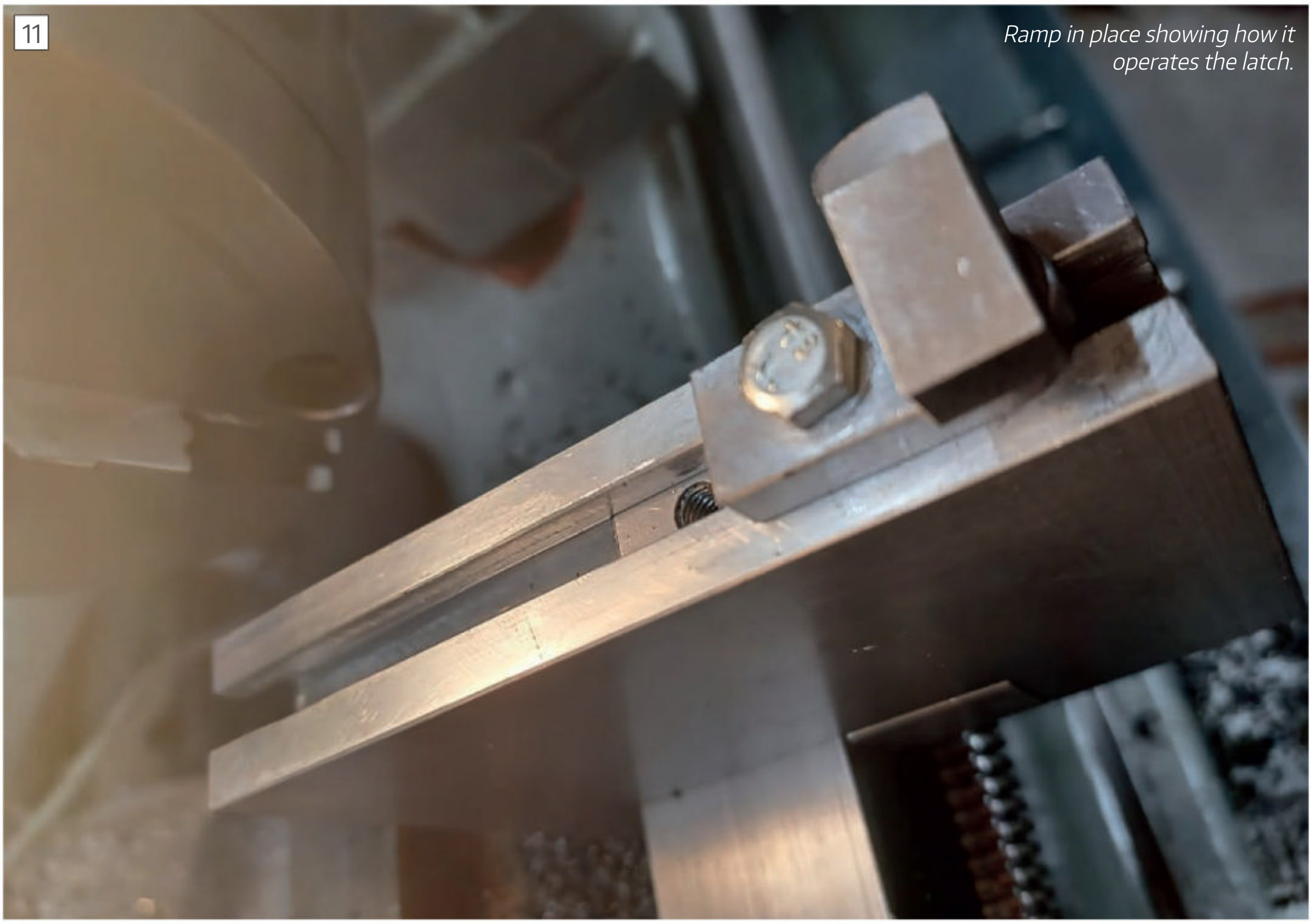

.250
.500
2.250
2.940
.265
.182
1.485
.750
2.000
1.250
.750
Drill and tap M6 x 1" deep
Ø.187
.500
.388
Bed Clamp Body
Mat'l: Aluminium

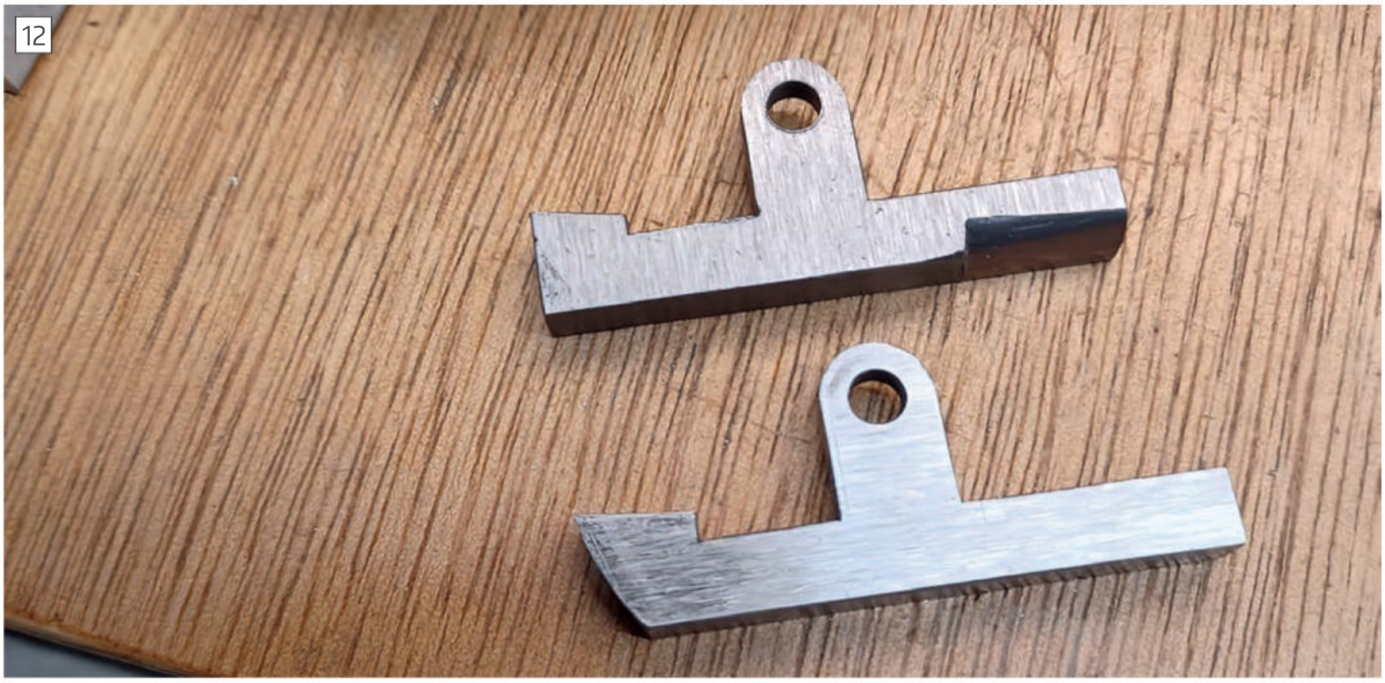
Figure 7.

The next job was to make a support and ramp to operate the latch and I decided to make it from ¾'' aluminium for body and clamp. The bottom was relieved to the shape of the bed so that the clamp holds it sturdily and can be moved whenever needed. The top has a T slot so the ramp can be adjusted for different diameter threads. I filled a radius on the latch corner so that the corner could slide up the operating ramp and measured when the latch operates so that the height is correct, and tool is on centre height for cutting. There are three parts the ramp, the piece which slides in the T slot and the clamp plate to hold the ramp and



11

Ramp in place showing how it operates the latch.



12

Straight and radiused latches.

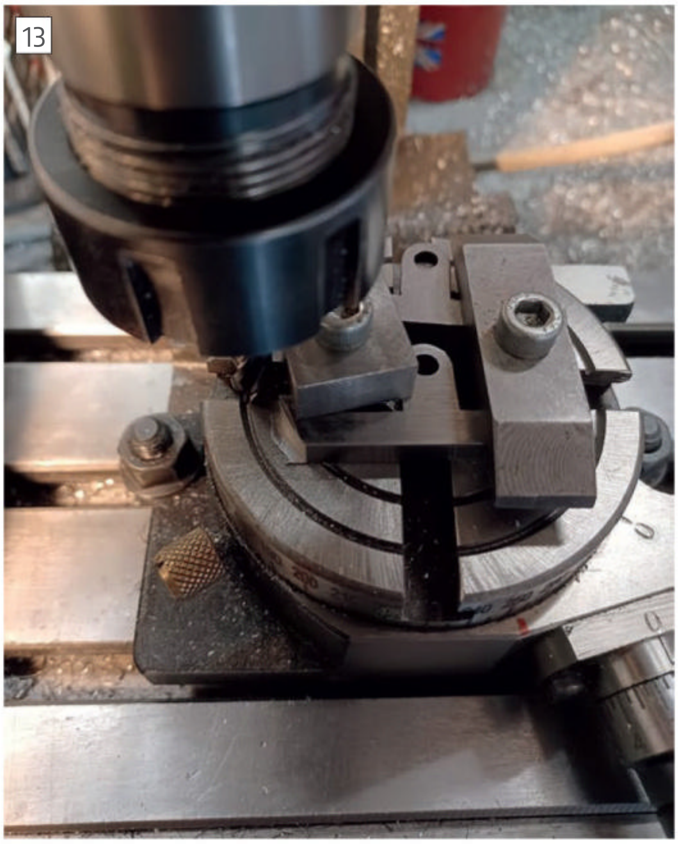
clamp the T slot to prevent movement, **photos 10** and **11.**

I tried my first thread cut and it started great but as the latch started to ride up the ramp the slide slightly moved back. In effect the end of the thread tapered instead of just latching back at the top of the ramp. I had forgotten the radial movement of the latch and I would need to remake the latch etc.

The new latch was made with a radial end face pivoting about the shoulder screw centre and a face was milled in the same fashion from same centre, **photo 12.** Milling the end of the latch radially is

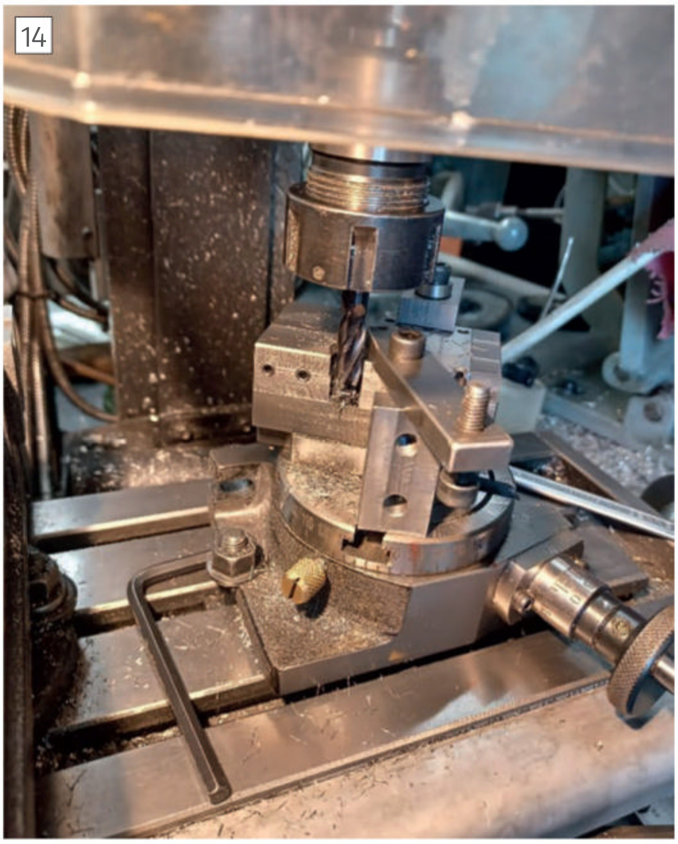
›

13



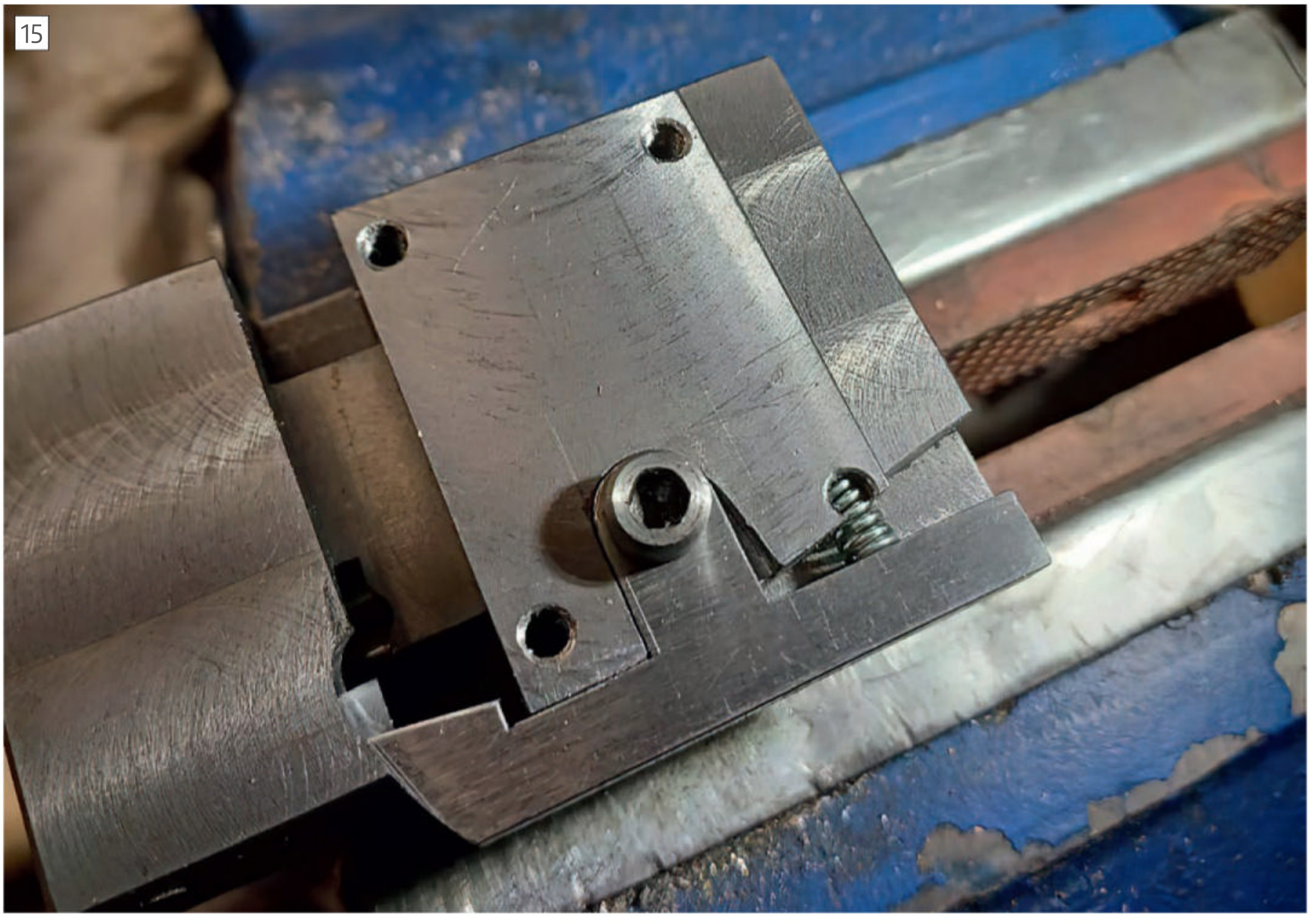
Milling latch.

14



Milling toolholder to match.

15



Finished latching mechanism.

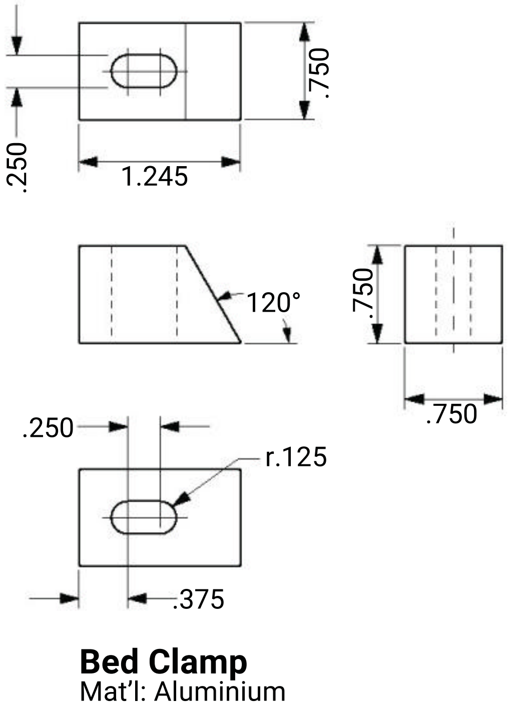

.250
1.245
.750
120°
.750
.750
.250
r.125
.375
Bed Clamp
Mat'l: Aluminium

Figure 8.

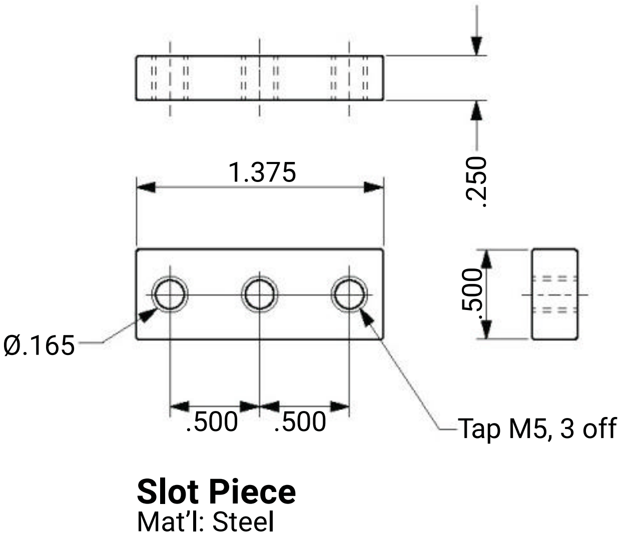

.250
1.375
.500
Ø.165
.500
.500
Tap M5, 3 off
Slot Piece
Mat'l: Steel

Figure 9.

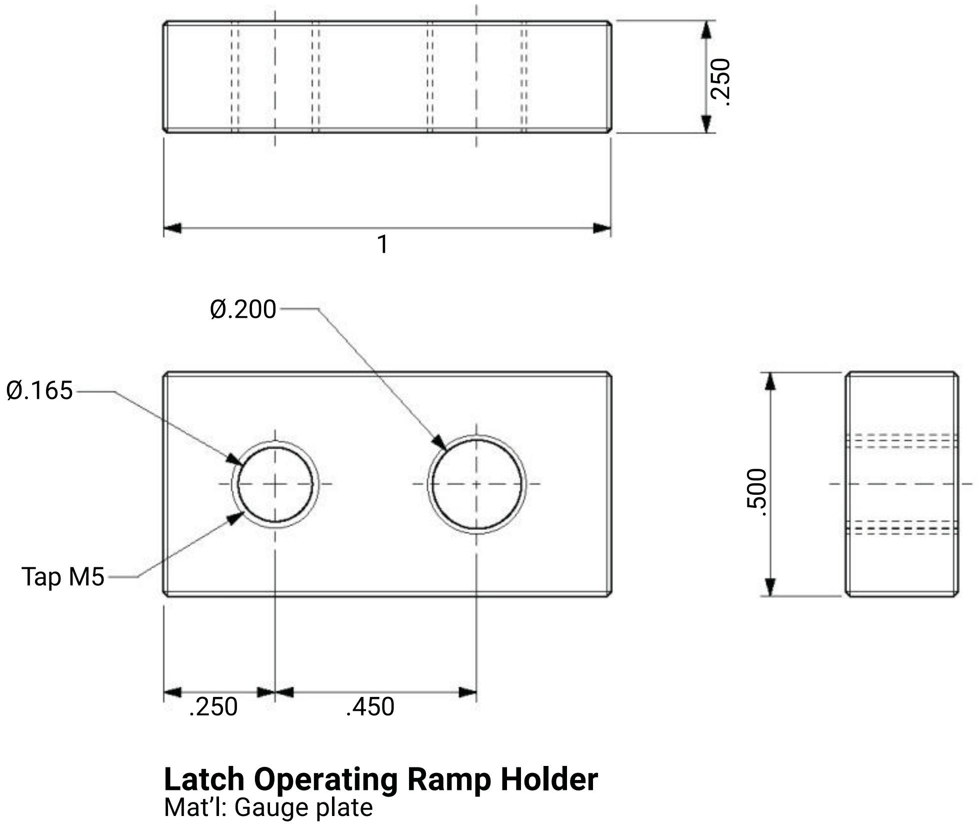
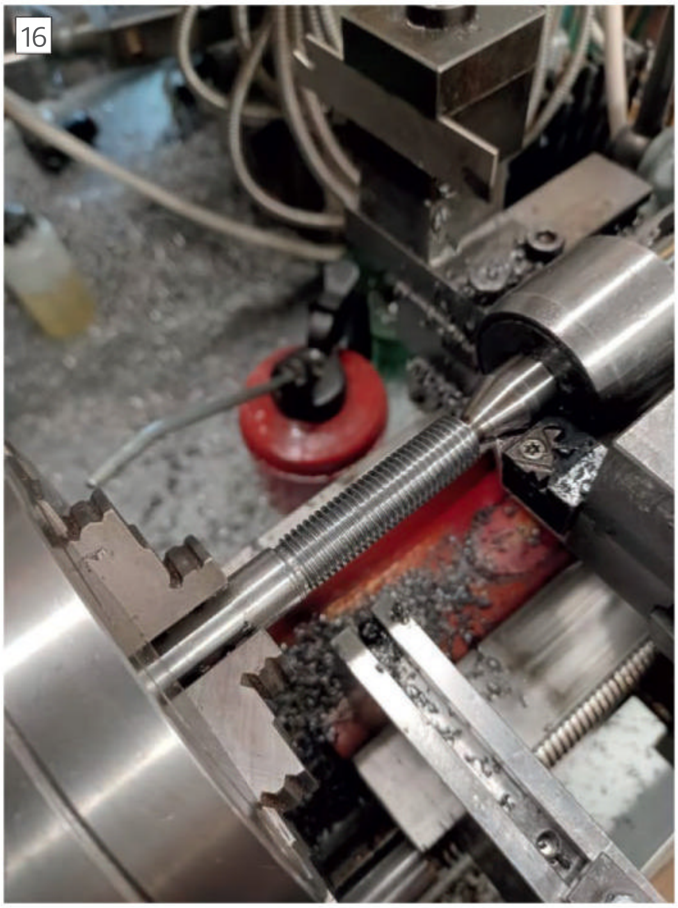

.250
1
Ø.200
Ø.165
Tap M5
.500
.250
.450
Latch Operating Ramp Holder
Mat'l: Gauge plate

Figure 10.

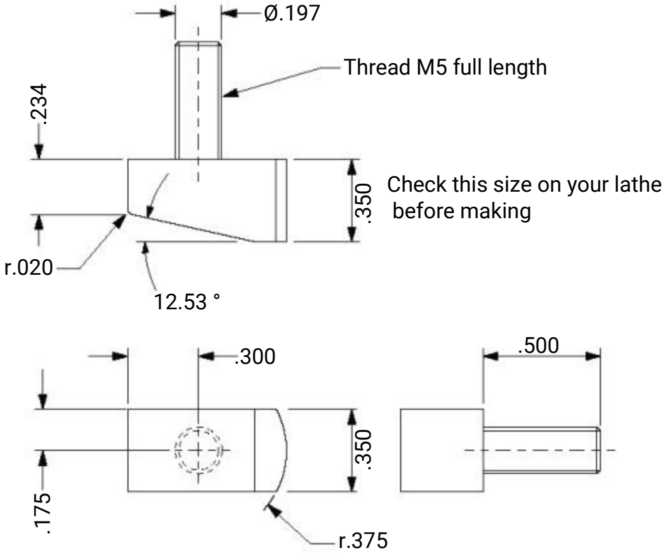


16

Practical test.

17

Finished text thread.


Ø.197
Thread M5 full length
.234
Check this size on your lathe
before making
.350
r.020
12.53 °
.300
.500
.350
.175
r.375

Latch Operating Ramp

Made from 3/4" silver steel.
Turn cut the thread, & screw it into the holder very tight.
Loctite on final assembly.
Then using the holder to get the squareness set, mill a flat.
Then remove the ramp operating ramp to finish the other faces.

Figure 11.

shown in **photo 13.**

Photograph 14 shows milling the body of slide to match the radial latch form.

Re assembled, **photo 15,** and re tried it works perfect no problem and I could double the original cutting speed, **photo 16**.

You can see the first trial on one end and a perfect ½'' BSF thread on the second end of the test bar, **photo 17**.

Videos of the tool at various stages and in action are oin the forum at www.model-engineer.co.uk.

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ME4 *= 5/32,3/16,7/32,1/4,9/32,5/16,3/8,7/16,1/2 (all 32tpi)*
BA3 *= 0,1,2,3,4,5,6,7,8,9,10* **Phone, Email Inquiries**

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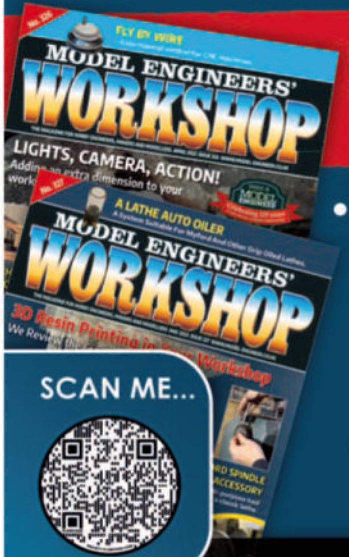

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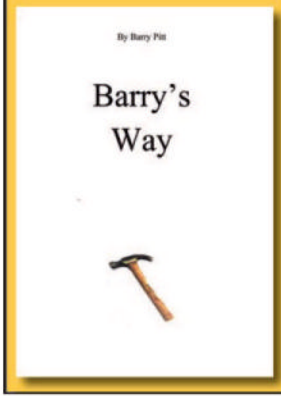
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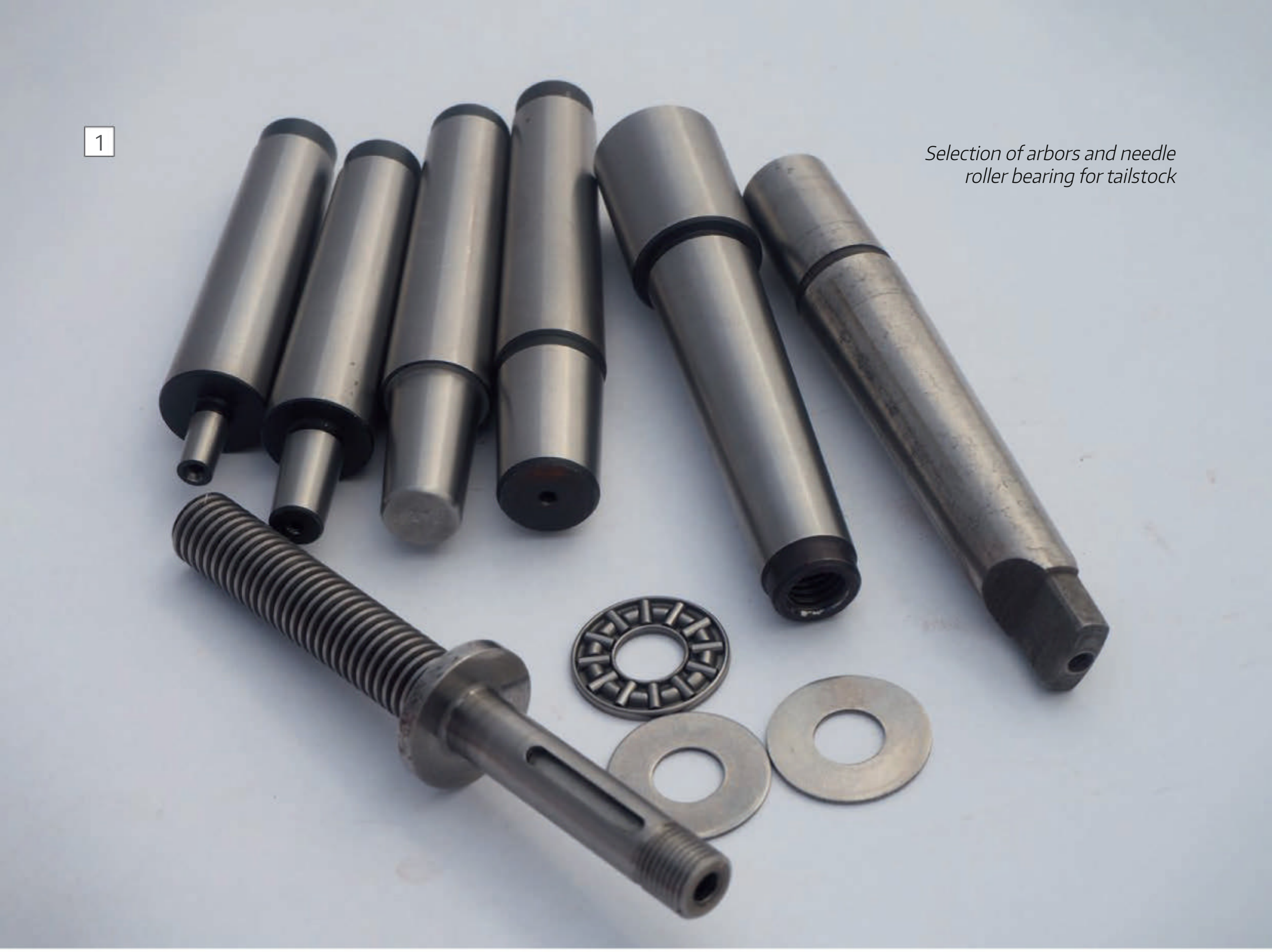

Selection of arbors and needle roller bearing for tailstock

Customising Morse Taper Arbors

Brett Meacle looks at an issue many beginners will notice when they first get a new lathe.

Almost every modern lathe has a tailstock with screw ejection of the Morse taper accessories- drill chuck, live centres etc. The travel of tailstocks on many hobby lathes is relatively short, around 40mm compared to industrial and even Myford super 7 lathes.

Coupled with short travel, using a tanged MT arbor reduces the travel even more, ejecting the arbor long before the zero mark is reached on the barrel. The standard tanged arbors are required with spindles in drill presses, mills and MT reducers machined with an ejection slot for use with a drill drift.

On a lathe with screw ejection, by using a customised arbor and tweaking the feedscrew, you can get a reasonable amount of extra travel out of the tailstock. But the greatest benefit is that the accessories will eject just as the barrel enters the tailstock body or at any point you determine.

One other mod that is easily done to the tailstock is to fit a needle roller thrust bearing between the feedscrew thrust face and the body, ideally with the hardened washer each side of the bearing but in a pinch just the needle roller bearing, **photo 1**.

The first drill chuck arbor I modified, I just shortened the tang and welded up the end for looks then shaped to taste.

You could do a similar thing with your tanged arbors still, but I now purchase them tapped with a drawbar thread – 3/8'' Whitworth or 10mm and plug them with a short bolt.

I started thinking how to hold arbors by the various Jacobs tapers (used for fitting drill cucks etc. to the arbors)

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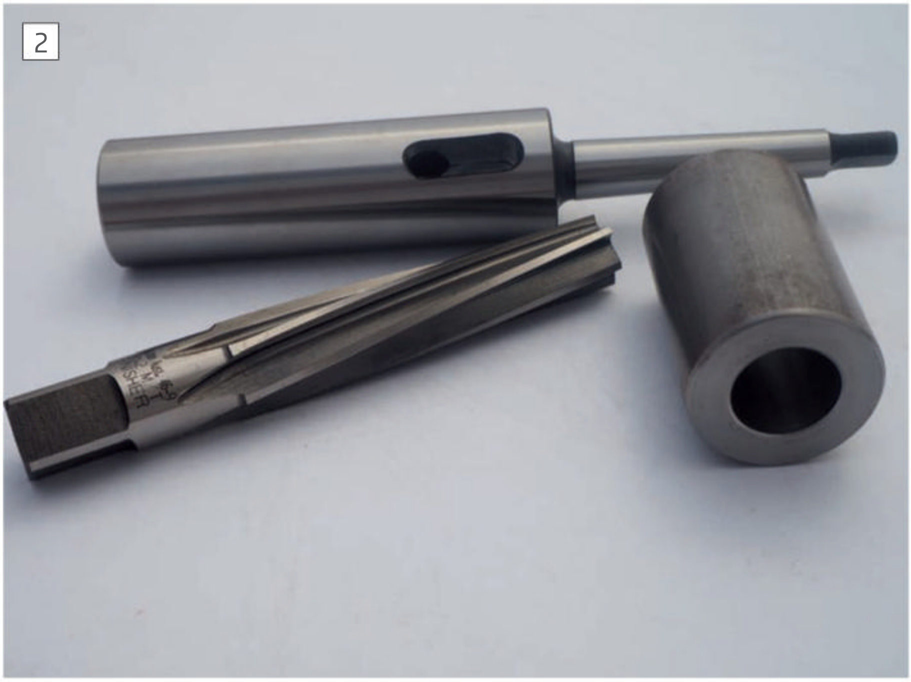
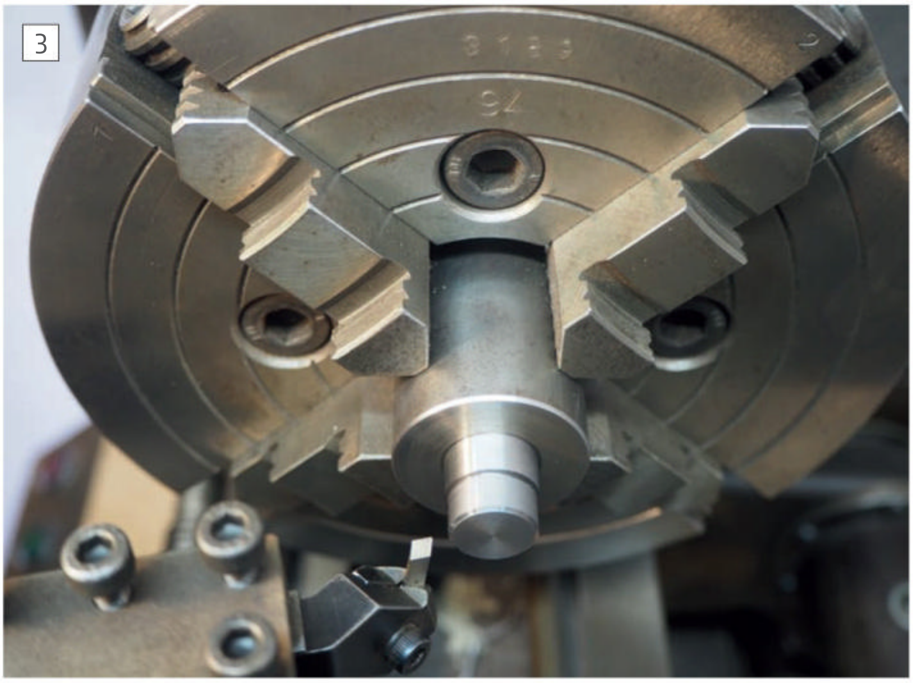


MT Extension socket, the adaptor and MT Reamer

3



Finish machining an arbor in the lathe

including some very small ones, until I realized that holding by the Morse taper would be a more rigid set up. Also once the length is determined it is repeatable for as many arbors as you need to modify. When machining a blank end Morse taper arbor, you insert it into the headstock taper to machine the business end. This time, however, we are wanting to machine the small end of the Morse taper itself. In order to do that, we need to reverse the arbor in the chuck.

You could purchase a MT socket extension or a capstan socket to modify. They have a straight body with the internal Morse taper. You just need to cut some material off the small end, so the arbor pokes out the required amount.

I had previously purchased a 2MT reamer that I had never used in anger and thought this would be a good practice job to improve my skills, so I decided to make a short 2MT capstan socket, **photo 2**. Extreme accuracy is not required as it is only to hold the arbor for shortening and turning the end plug to shape.

To customise your arbor to suit your lathe, first work out how much to remove from each one.

Insert the arbor in the socket then mount in the lathe chuck and ensure it runs as accurately as you desire, perfect concentricity is not required. Shorten to length, taking into account the thickness of the plug on the final length. Chamfer the thread and screw a plug in tightly.

The plug is just a short bolt with an undercut machined into the head to allow it to screw up flush in the arbor. Turn the flats off the head of the bolt to suit and then face the end to the final length using the end of the adaptor as a datum, **photo 3**. Repeat for as many arbors as you need.

If you add the thrust bearing, you may have to shorten the feed screw slightly to compensate. It's a balancing act between the length of travel you want and the length of the MT arbor. Now you can have all your accessories matched to the lathe to get the optimum performance out of them.

An Update (heavy duty holder design)

As time progressed, thoughts turned to the holding power of my original holder, which I have found fine with careful working for the light machining of the arbor ends.

Morse taper arbors hold well as they are self-holding when clean and inserted correctly and pressure is pushing the arbor into the taper but in this instance, we are working in the opposite direction. What if you wanted to do more aggressive work, drill and tap a new thread or change thread sizes? Also some purchased MT arbors are hardened or made from tougher steels which makes modifying them harder work requiring a little more machining power. I was sure my original design would struggle to hold sufficiently for this heavier duty work.

If you were making a new Morse taper from scratch as suggested by George Thomas in his Book "The Model Engineers Workshop Manual", Holding the work is not a problem as you can follow two basic machining principles, plan the work to complete as many operations as possible at the same

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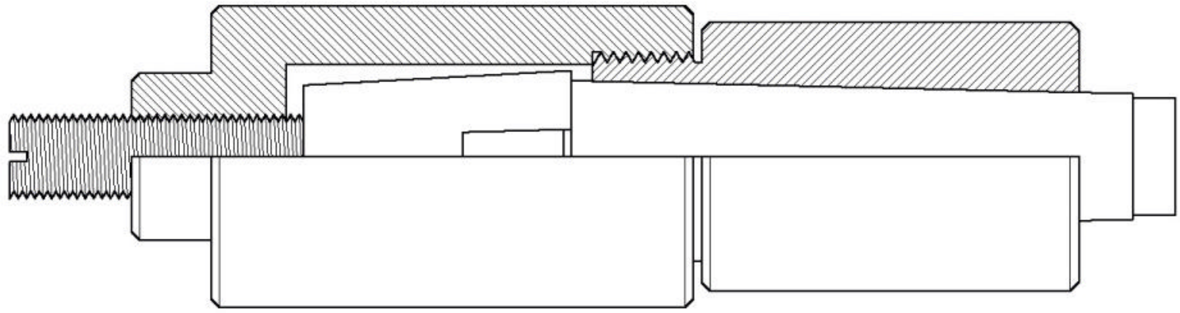
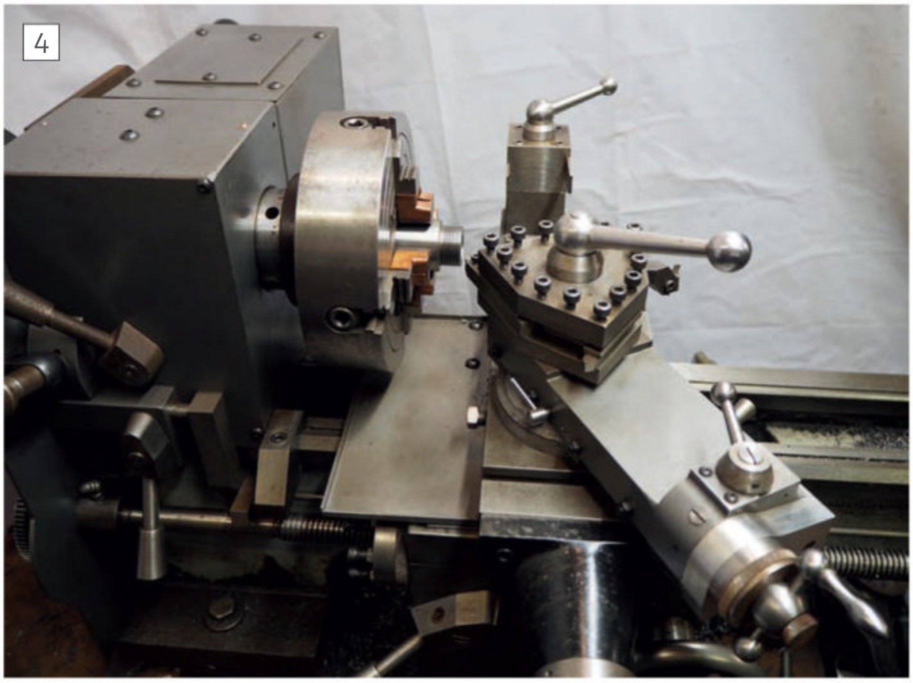


Figure 1. Section of Morse taper holder



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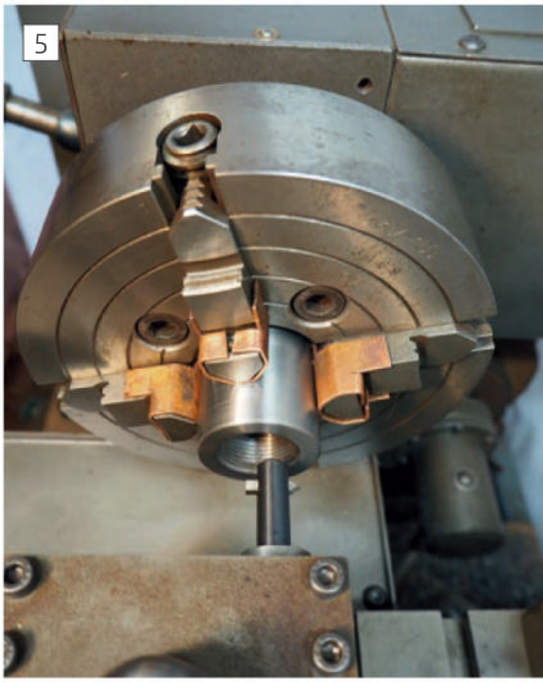
GHT Retracting topslide screwcutting the thread



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Screwcutting body internal thread

setting and only remove the item from the parent bar or chucking piece as late as possible in the machining sequence. Because the object we are trying to hold firmly is tapered, slippery and awkward as well as not wanting to damage the finely machined surfaces in the process, a cunning plan had to be thought up.

A new longer two-part holder was devised with a threaded depth stop that screws in and stops the MT arbor from moving forward and loosening in the holder during machining operations, **fig. 1.** The adjustable stop is to accommodate the lengths of differing sizes of Jacobs Tapers.

It is a bit of an extravagant workholding method but is a good skill-building project and once made can be used for as many tapers if you have the need. Once it is set up for a particular size arbor, it is just a matter of unscrewing the assembly, removing the already machined one and inserting a new one then screwing together again.

The actual machining is straight forward. First the nose piece is set up in a chuck and a full depth hole is drilled to create the tapered hole. To reduce wear on the reamer, I trammed the topslide to the angle of the 2mt using a dial indicator set up on a good arbor between centres. Adjusting the angle until the dial indicator reading stayed on the zero mark when traversing from one end to the other. A 3/8'' boring bar was used to remove most of the material. You could complete the whole job using the boring bar to create a fine finish, adjusting the taper angle to match the arbor with engineers bearing blue on a good arbor to get an even fit along the full length. Get a feel for how much the arbor recedes into the nosepiece as a small amount of metal removal from the MT bore can move the inserted arbor a surprisingly long way.

Finally ream the socket using a finishing MT Reamer, paying particular attention to the depth the arbor seats into the nosepiece. Machine the external thread at the same time to ensure concentricity with the bore.

The body is completed in a similar way, drill and tap the adjuster screw hole. For the stop screw, needed to adjust to the

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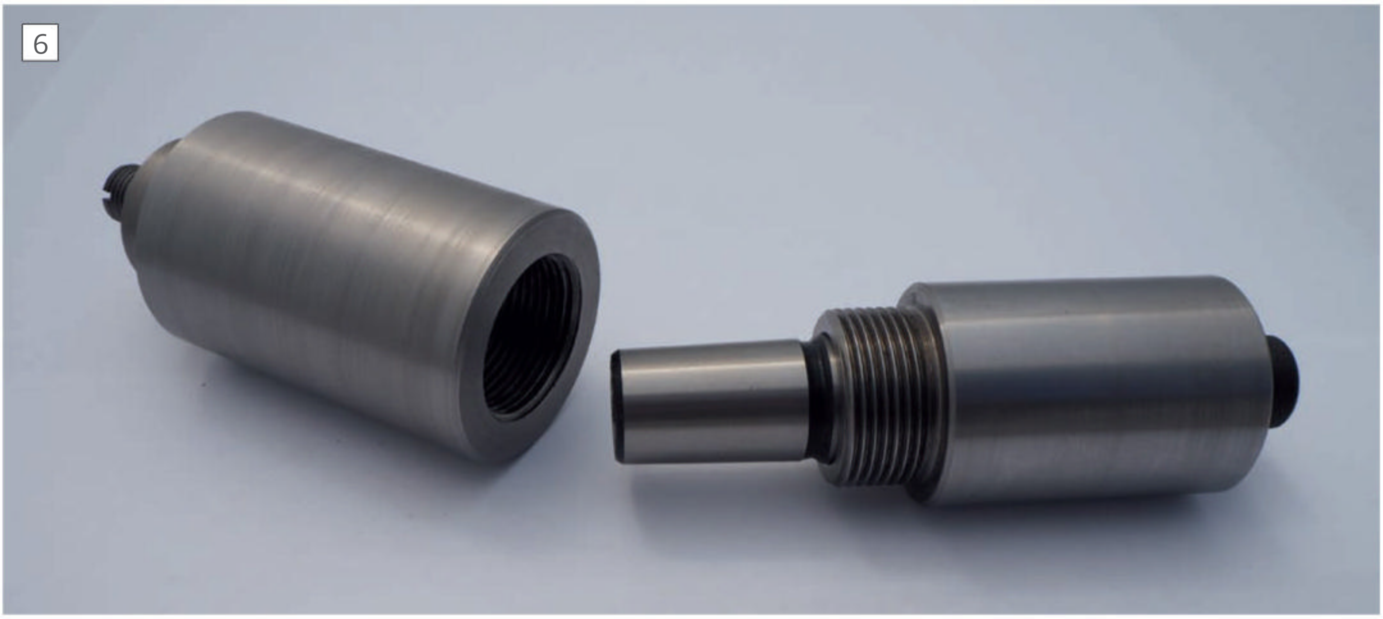

Completed holder with arbor inserted in nose

various Jacobs taper sizes, you will have to make new or modify a ready-made screw. Reverse in the chuck to machine the important bits, Bore the recess to accommodate the largest Jacobs taper you might use then screw cut the internal thread a close smooth fit to mate with the nose piece.

When screwcutting the threads, depending on your lathe setup and experience, threading under power is an option with a suitable spindle speed and experience, life is made far simpler with a screwcutting clutch fitted but can also be completed with a spindle mandrel handle and man power. A mandrel handle is another good project with which to build your skills and well worth the effort.

As I was using a Geo Thomas retracting topslide which moves the toolbit away from the thread being machined when returning to the start point, **photo 4.** When it came to the internal thread in the body the vee tool was mounted upside down and the metal removed from the rear side of the bore, **photo 5.** Working on the rear of a hole with an upside-down tool allows you to get better view of some jobs and normal spindle rotation is still used.

The only other thing is to decide on how you might want to tighten the two parts together e.g. flats for a spanner, Pin spanner holes on the end , a radial hole for a C spanner or even grooves similar to an ER collet nut, the choice is yours. You don't have to crank it in, just enough pressure so the arbor is firmly held. Too tight might make removal of the arbor hard as people with MT Mill Spindles and drawbars learn.

In practice the body is held in the chuck, the arbor inserted into the nose piece, **photo 6,** then screwed together and nipped up when the JT is stopped by the adjustable screw. The workpiece is checked and is adjusted for accurate centring if necessary, then the work required completed. The nose piece unscrewed to remove the MT arbor and if you're machining up more than one item, the next arbor inserted, **photo 7.**

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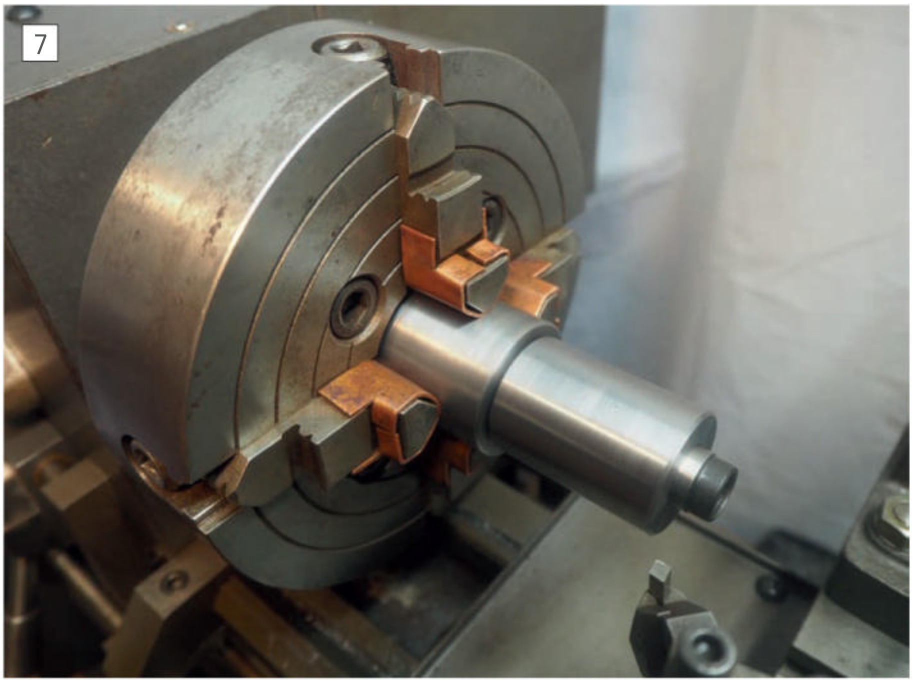
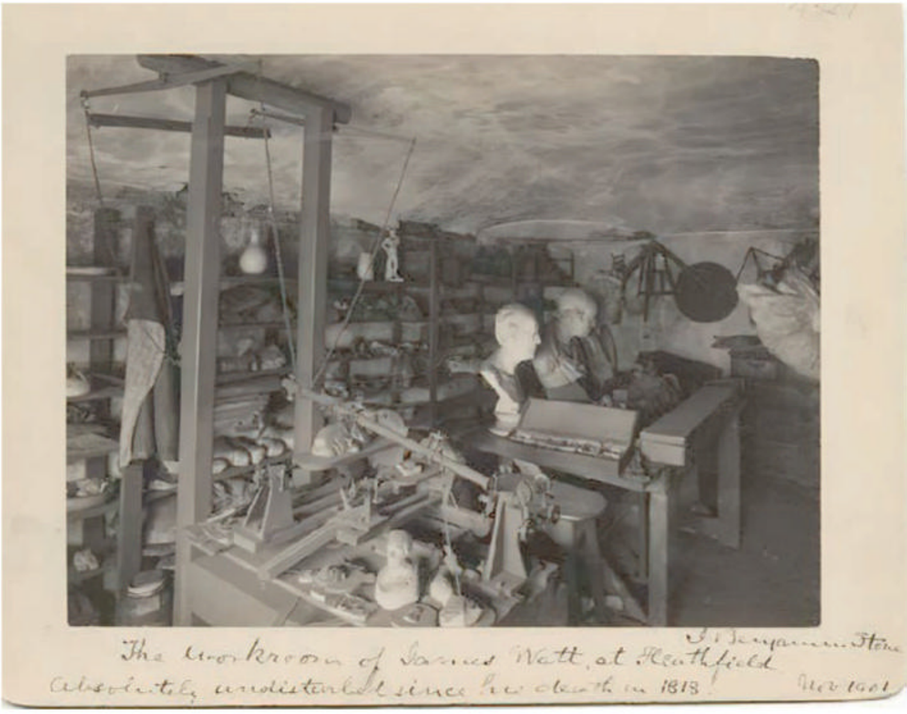


Holder fitted to lathe and modifying an arbor

The holder is shown is for 2MT but the design can be scaled up or down to suit other sizes. The threads used can be your choice to suit the gear you have, I used 10 x 1mm for the adjuster screw and 25 x 1.5mm for the body.

These projects, either the simple holder or the heavy duty one, are not something you may use often but the skills practiced including producing a Morse Taper socket , internal and external threading, work holding and planning, all help with building up your skills for further more complicated jobs as your confidence builds. ▮

Tales from the Workshop: James Watt


The workroom of James Watt, at Heathfield
Absolutely undisturbed since his death in 1818!
J. Benjamin Stone
Nov 1901

"The workroom of James Watt at Heathfield. Absolutely undisturbed since his death in 1818". Photograph taken in 1901, ***MS 2724/2/B/4327*** *used by kind permission of the Library of Birmingham.*

James Watt is known chiefly for his significant contributions to the development of the steam engine. Watt's early life was marked by various challenges and significant events. He was born on January 30, 1736, in Greenock, Renfrewshire, Scotland. He came from a relatively modest background. His father, James Watt Sr., was a shipwright and contractor, while his mother, Agnes Muirhead, was from a distinguished family of mathematicians and teachers.

As a child, Watt suffered from poor health, including frequent bouts of illness. Due to his frailty, he spent much of his time at home, where his mother taught him basic reading, writing, and arithmetic. His interest in mathematics and engineering developed during these early years. At the age of 17, Watt became an apprentice to a Glasgow instrument maker named John Morgan. During his apprenticeship, he gained practical skills in instrument making and repair, which formed the foundation of his future career.

After completing his apprenticeship, Watt attended the University of Glasgow. Although he did not pursue a formal degree, he attended lectures and gained access to the university's scientific apparatus. This experience further nurtured his interest in scientific experimentation and invention. Following his time at the university, Watt set up his own instrument-making workshop in Glasgow. He established a reputation for his expertise in building and repairing scientific instruments, which led to his involvement with the University of Glasgow as an instrument maker.

While working at the university, Watt became acquainted with the Newcomen steam engine, which was used to pump water out of mines. His interest in improving the engine's efficiency led him to conduct experiments and develop the separate condenser, a pivotal invention that revolutionized steam engine technology by greatly increasing their efficiency.

To further refine his invention, Watt partnered with Matthew Boulton, a prominent industrialist, in 1775. They established the Soho Engineering Works in Birmingham, England. Their collaboration resulted in the development and commercialization of the improved steam engine, known as the Watt steam engine. This invention revolutionized industry and played a crucial role in the Industrial Revolution.

James Watt's early experiences, including his apprenticeship, education, and engagement with scientific instruments, laid the foundation for his later achievements in engineering and steam engine development.

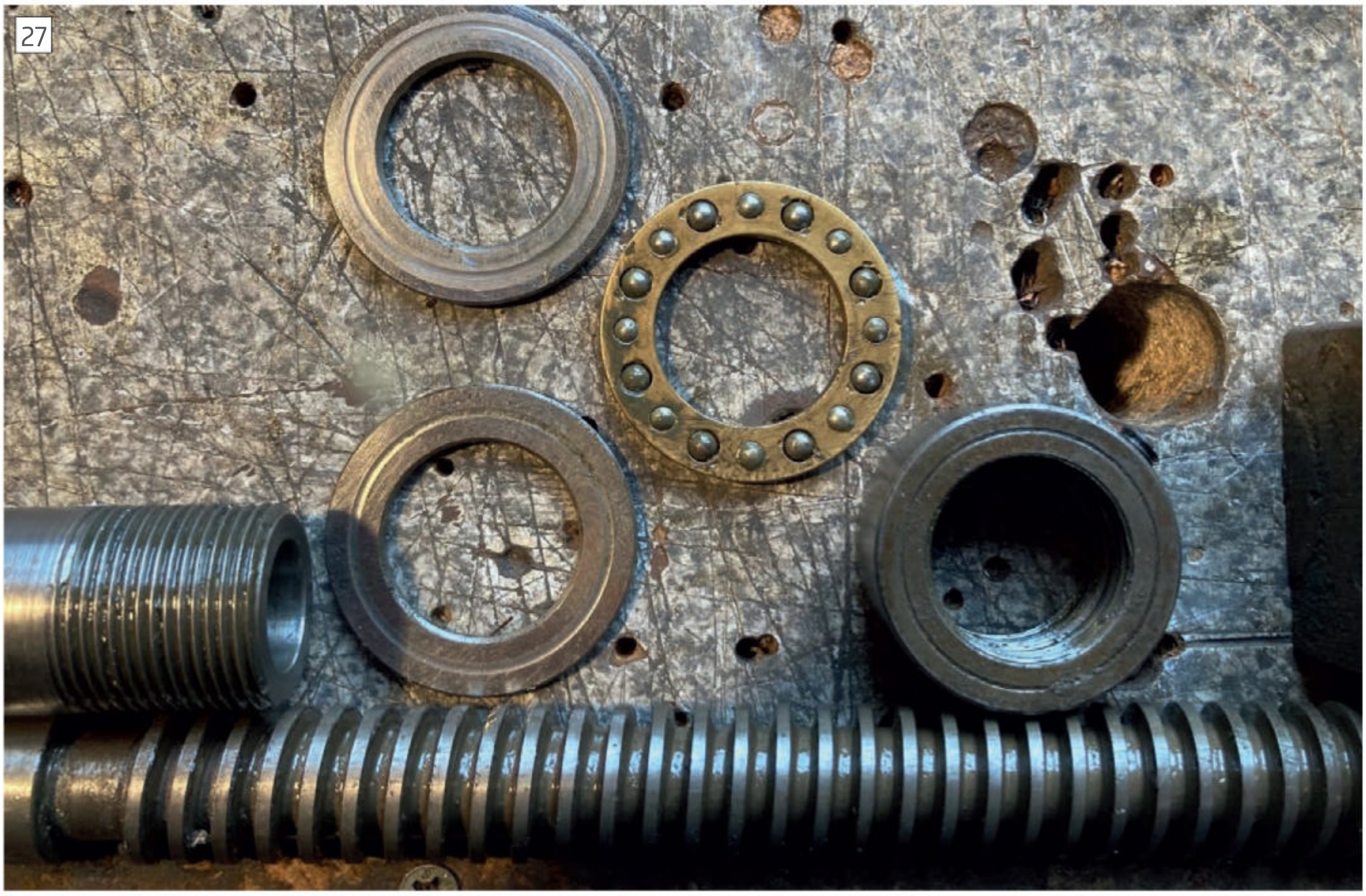
The original workshop of James Watt at Heathfield Hall in Staffordshire, **photo 1,** is now housed in the Science Museum in London, United Kingdom. The workshop was reconstructed within the Science Museum to preserve and showcase the environment where James Watt conducted his experiments and made his inventions. The workshop provides visitors with a glimpse into the life and work of this renowned engineer and inventor.

The workshop contains many original artifacts, tools, and machinery associated with James Watt's career. It includes his original workbench, personal belongings, and a collection of his instruments and models. The workshop also features interactive displays and exhibits that explain Watt's contributions to steam engine technology.

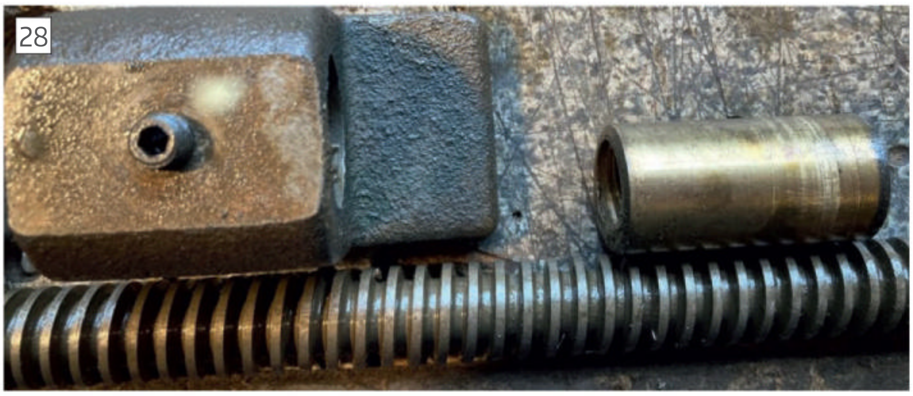
Visitors to the workshop can learn about Watt's partnership with Matthew Boulton, see the development of his steam engine models, and understand the significance of his separate condenser invention. The exhibit highlights the impact of Watt's innovations on the Industrial Revolution and their lasting influence on engineering and industry.

An Eagle Surface Grinder

Bob Trethewey concludes his strip down of a Dronfield Eagle Surface Grinder in preparation for a full restoration.



The cross-slide screw threaded central spacer will then come off outward, leaving the screw with its internal thrust bearing and both its endplates as well as the internally threaded adjuster nut, **photo 27.** The cross-slide screw will droop at this point allowing the feed screw's threaded housing to drop down from the lower platen, **photo 28**. The lower platen could now be pulled off the knee, after undoing three set screw adjusters and their lock nuts as well as two gib locking bolts, **photo 29**, the lower platen gib is then slackened off. Pull the platen away from the machine column; this item's weight is 31kg. A grub screw retaining the feed screw's adjustment nut inside the nut housing is unlocked. The pitch of this feed screw is 5 teeth per inch left hand



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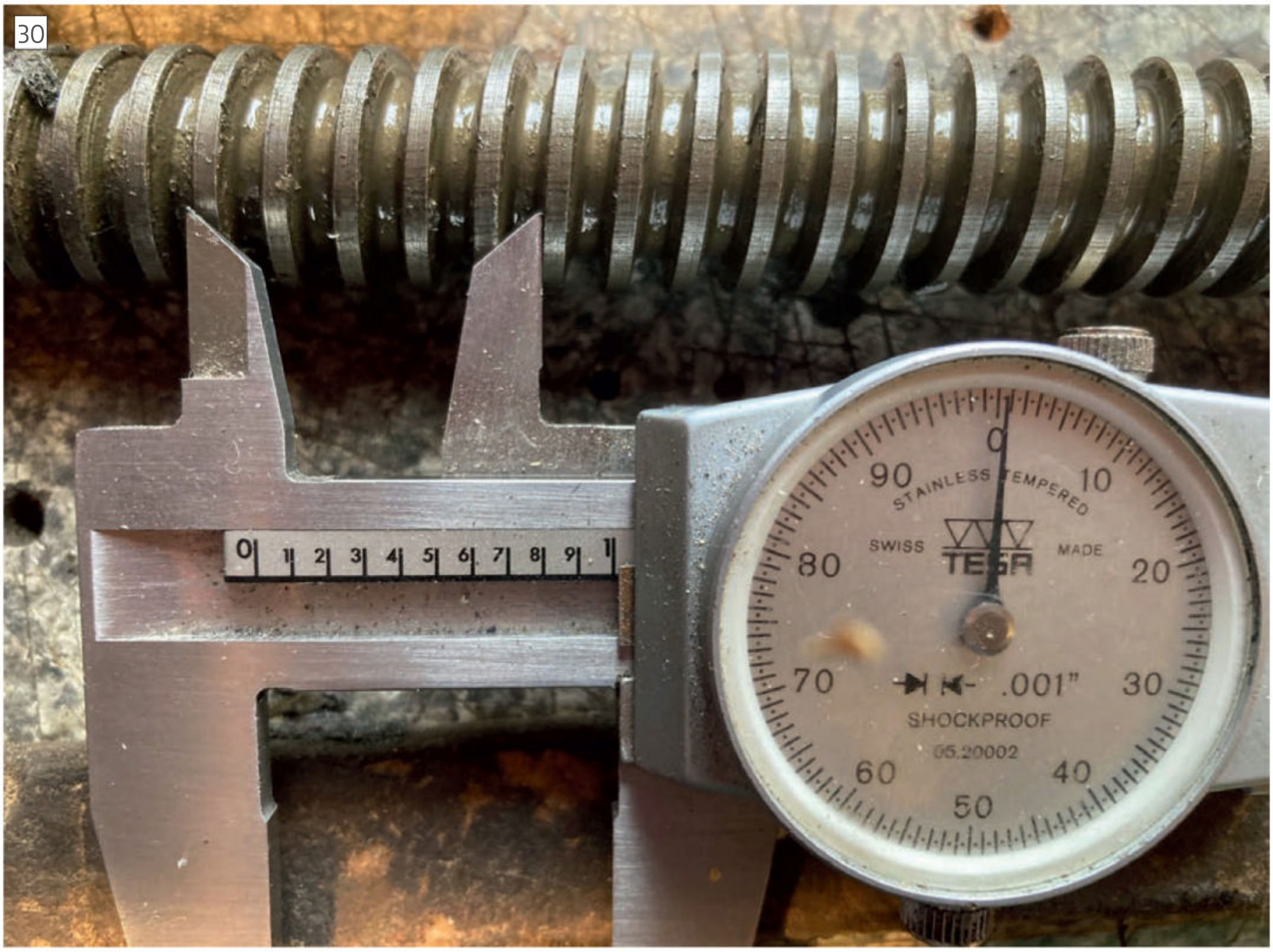
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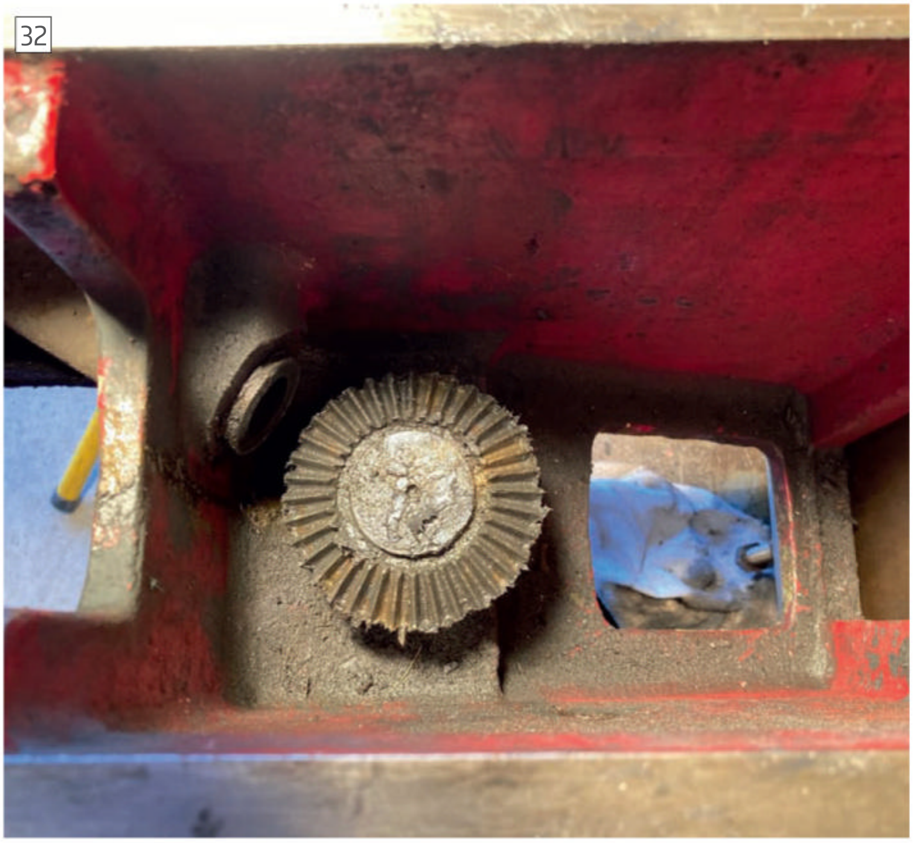
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ACME thread, **photo 30.**

With the cross slide lower platen removed the knee wheel handle, **photo 31** and its associated bearings can be removed once the bevel gear has it's retaining nut removed. There is a spacer washer to be removed which is

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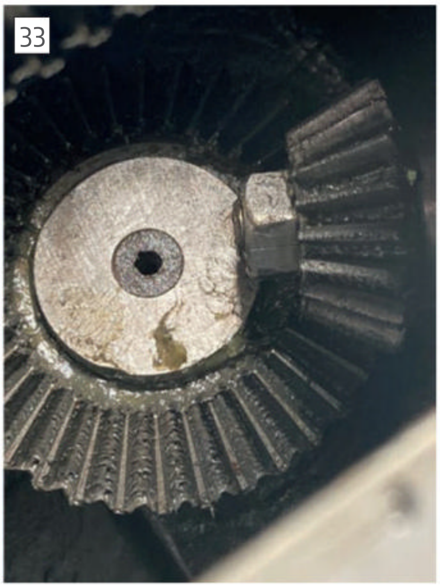

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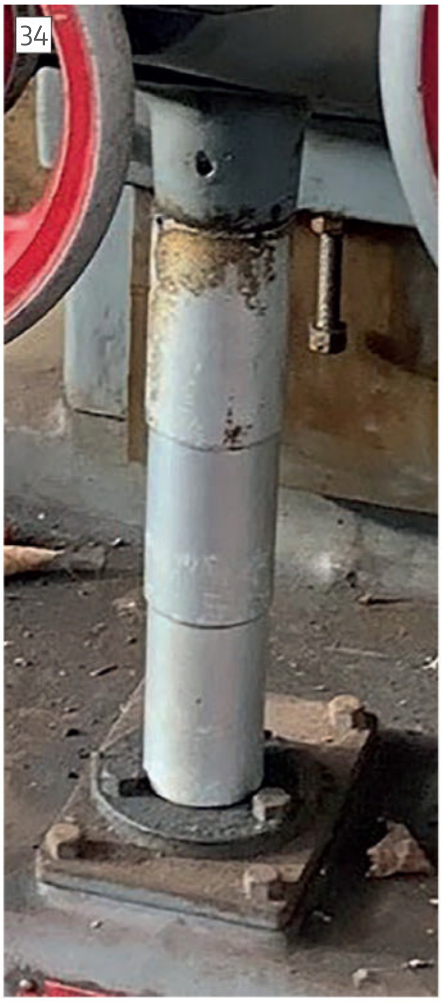

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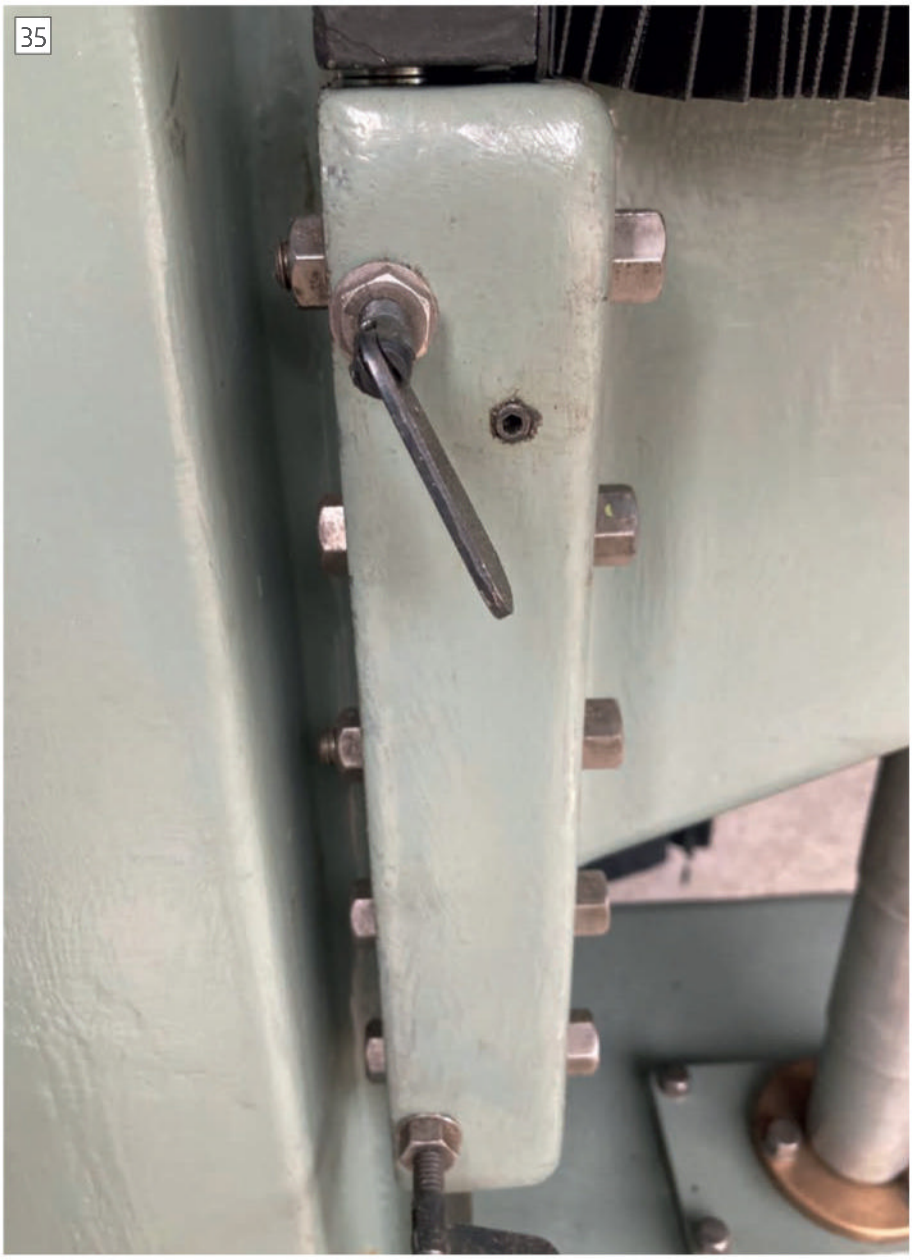

exposed when the knee wheel shaft is taken off the machine shown in **photo 32**. The vertical knee screw bevel gear is also shown in **photo 33** this has a countersunk BSW bolt and retaining washer which needs removing, Do NOT attempt to pull this vertical screw bevel gear off its keyed shaft as the gear has a grub screw underneath the gear face opposite the shaft key way. When this grub screw is untightened, the gear come off the shaft easily exposing a spacer washer which keeps the bevel gear underside away from the knee casting.

The vertical screw is protected by a set of four sliding aluminium sleeves, each sleeve being slightly smaller in diameter as it progresses downward from the top. At the top of the screw is a spacer washer and a thrust washer with a top and bottom backing washer the screw is a 20 tooth per inch giving the user a vertical movement of 0.050in per single revolution. The wheel which operates this vertical screw has a calibrated circular dial divided into fifty segments each being a vertical movement of 0.001in. The vertical screw runs in a phosphor bronze nut which has three retaining screws. The nut sits upon a rectangular mounting plate which has four bolts retaining it to the top of the grinder's base, **photo 34**.

There are a set of five vertical gib locking bolts nuts and washers holding the vertical knee gib in place, **photo 35**, these need to be unlocked. As well as the locking bolts there are two BSW long reach grub screws with their lock nuts, which are the gig adjuster screws, and need slackening off. Now the knee can be lifted off the column. When the knee is at the top of its vertical slideway the cross-slide feed screw can be removed from the knee casting,

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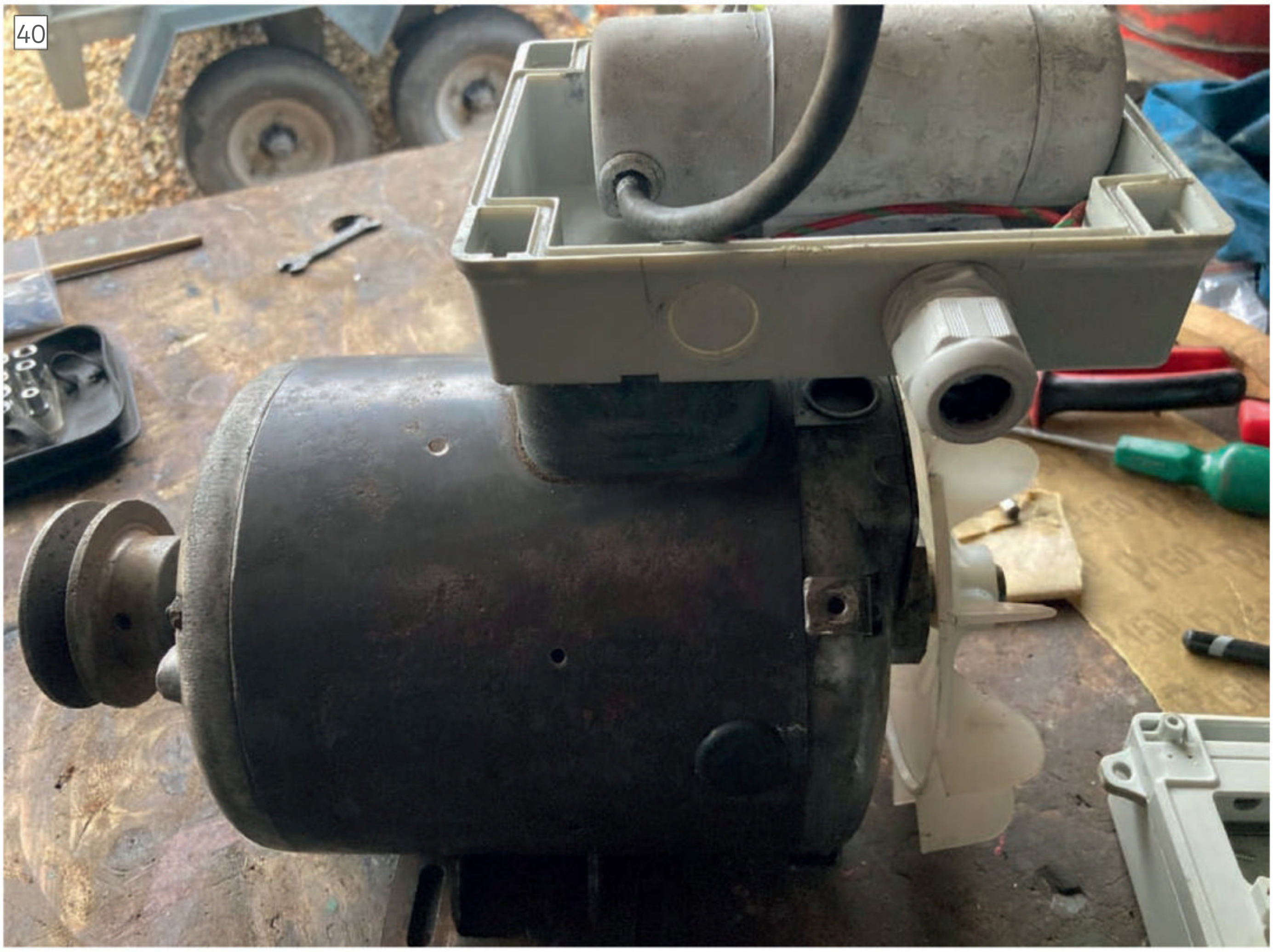

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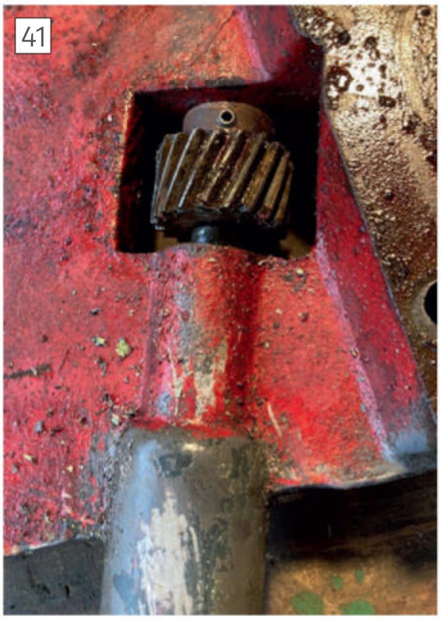

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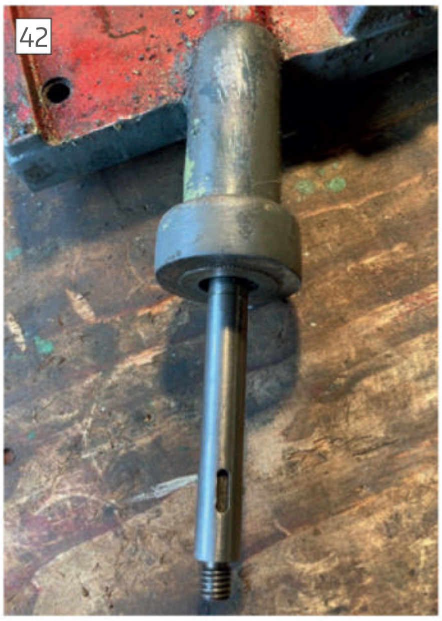

including its adjustment nut thrust washer and two side washers and a spacer. The knee weight is 41kg. See **photo 36**.

With the knee removed the knee vertical feed screw assembly can be removed from the machines base, **photo 37**. Removal of the machine base's two outer covers exposes the internally mounted electric motor, mounted on a hinged base plate, **photo 38**, allowing it to tension the drive belt which connects with the drive spindle. The motor has had a waterproof box added to it to hold its capacitor in case the machine is converted to run wet in the future. See **photos 39** and **40**

The most interesting aspect of the strip of this machine came with the removal of the top platen of the cross slide's operating handle and shaft. This shaft is connected through the casting to engage with a pinion gear that operates the rack enabling the platen to be moved from side to side with minimum effort and maximum control via its feed wheel.

The wheel once removed, **photo 41**, shows a pressed washer which has a knurled outer edge, this provides a friction fit into the casting boss. With the pinion lock nut untightened via its grub screw, **photo 42**, partially unscrewed from the shaft thread I had to produce a set of hollow tubes that went over, outside of, the pressed washer spacer and which had enough internal depth to allow me to pull out

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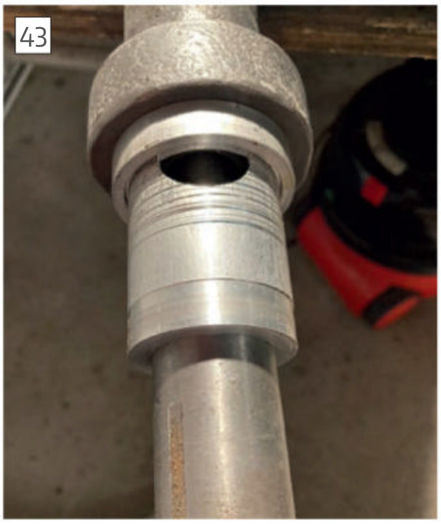
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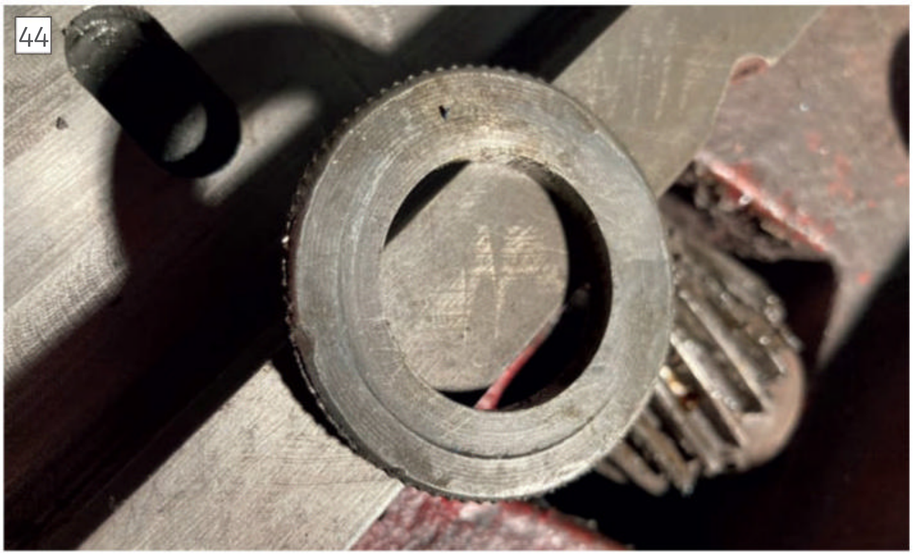
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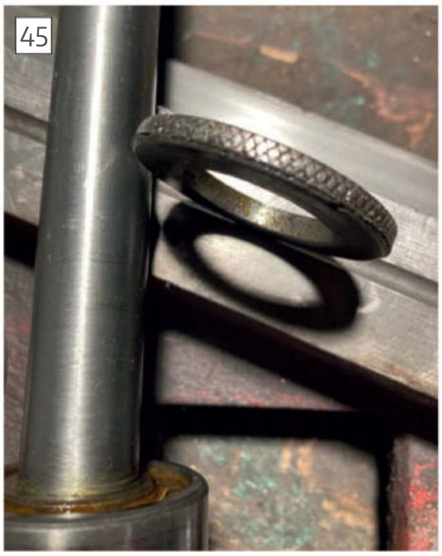
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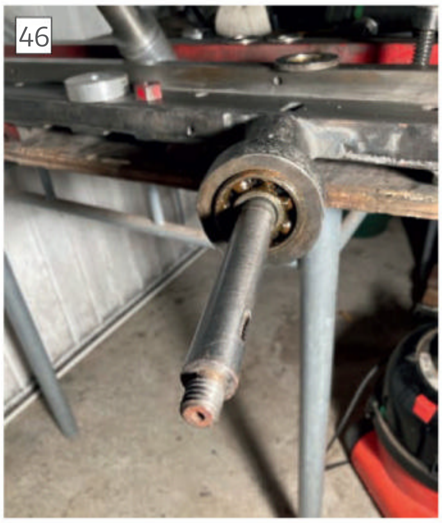
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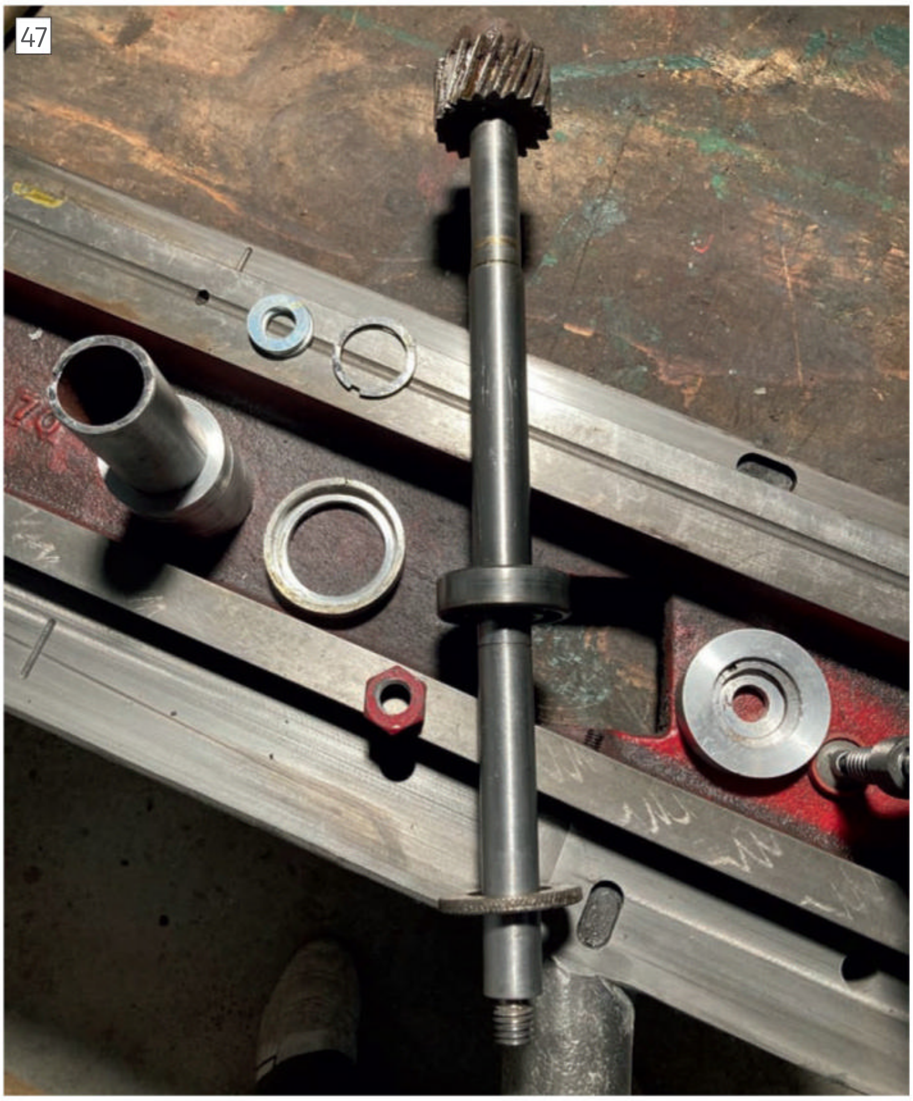
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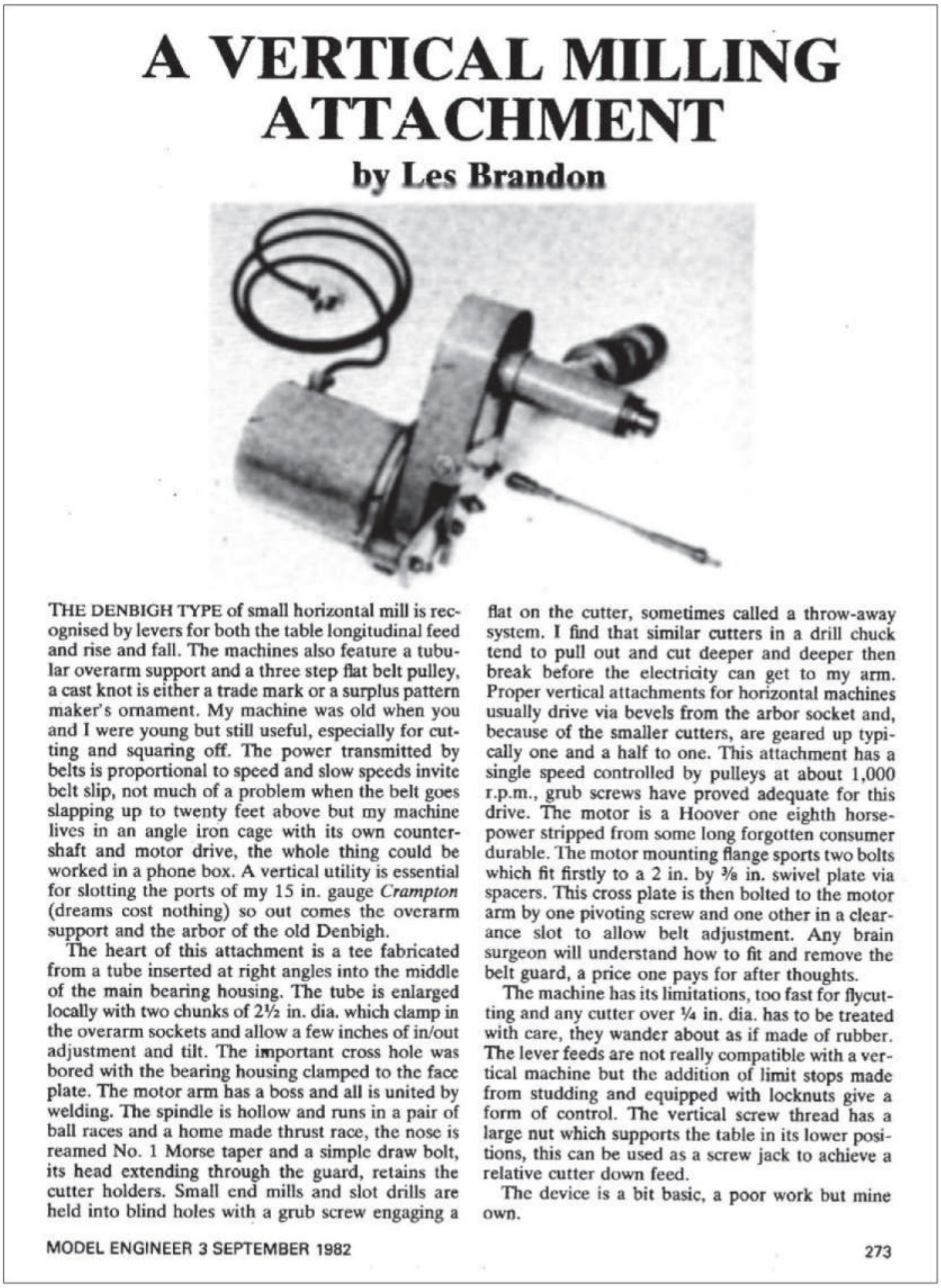
the shaft by using the shaft's wheel nut. See **photo 43.**

Using the wheel nut and gradually turning it to pull the shaft out of the boss the knurled washer spacer came away from the casting, **photos 44** and **45** this allowed the shaft bearing to be removed **photo 46**. Care must be taken during this time to ensure you keep unscrewing the pinion lock nut and when that is free the pinion can be removed remember to retrieve the pinions key from the shaft before the shaft is pulled back into the casting, **photo 47.**

This concluded the strip of the machine where all the parts were cleaned thoroughly and labelled for use in the eventual rebuild if not replaced with new items. ▮

From the Model Engineer Archive

To celebrate 125 years of Model Engineer magazine and the Society of Model and Experimental Engineers, each issue in 2023 features fascinating historic content from Model Engineer relevant to workshops, tools or techniques. These pages from Model Engineer Volume 149, No. 3688 – September 3, 1982, feature two interesting ideas, a vertical milling attachment and a device to aid drilling holes in sheet metal.



A VERTICAL MILLING ATTACHMENT

by Les Brandon

THE DENBIGH TYPE of small horizontal mill is recognised by levers for both the table longitudinal feed and rise and fall. The machines also feature a tubular overarm support and a three step flat belt pulley, a cast knot is either a trade mark or a surplus pattern maker's ornament. My machine was old when you and I were young but still useful, especially for cutting and squaring off. The power transmitted by belts is proportional to speed and slow speeds invite belt slip, not much of a problem when the belt goes slapping up to twenty feet above but my machine lives in an angle iron cage with its own countershaft and motor drive, the whole thing could be worked in a phone box. A vertical utility is essential for slotting the ports of my 15 in. gauge *Crampton* (dreams cost nothing) so out comes the overarm support and the arbor of the old Denbigh.

The heart of this attachment is a tee fabricated from a tube inserted at right angles into the middle of the main bearing housing. The tube is enlarged locally with two chunks of 2½ in. dia. which clamp in the overarm sockets and allow a few inches of in/out adjustment and tilt. The important cross hole was bored with the bearing housing clamped to the face plate. The motor arm has a boss and all is united by welding. The spindle is hollow and runs in a pair of ball races and a home made thrust race, the nose is reamed No. 1 Morse taper and a simple draw bolt, its head extending through the guard, retains the cutter holders. Small end mills and slot drills are held into blind holes with a grub screw engaging a flat on the cutter, sometimes called a throw-away system. I find that similar cutters in a drill chuck tend to pull out and cut deeper and deeper then break before the electricity can get to my arm. Proper vertical attachments for horizontal machines usually drive via bevels from the arbor socket and, because of the smaller cutters, are geared up typically one and a half to one. This attachment has a single speed controlled by pulleys at about 1,000 r.p.m., grub screws have proved adequate for this drive. The motor is a Hoover one eighth horsepower stripped from some long forgotten consumer durable. The motor mounting flange sports two bolts which fit firstly to a 2 in. by ⅜ in. swivel plate via spacers. This cross plate is then bolted to the motor arm by one pivoting screw and one other in a clearance slot to allow belt adjustment. Any brain surgeon will understand how to fit and remove the belt guard, a price one pays for after thoughts.

The machine has its limitations, too fast for flycutting and any cutter over ¼ in. dia. has to be treated with care, they wander about as if made of rubber. The lever feeds are not really compatible with a vertical machine but the addition of limit stops made from studding and equipped with locknuts give a form of control. The vertical screw thread has a large nut which supports the table in its lower positions, this can be used as a screw jack to achieve a relative cutter down feed.

The device is a bit basic, a poor work but mine own.

Model Engineer
IMLEC REPORT

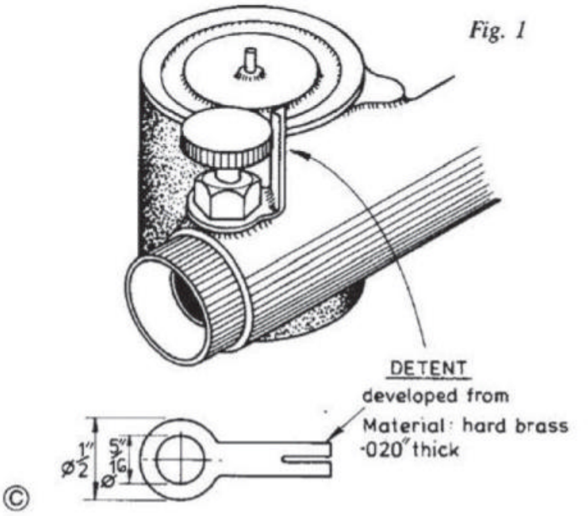
FORMING HOLES IN THIN METAL

by Ian Bradley

IT IS SOMETIMES necessary to form holes in thin material such as brass and steel shim. Unless these are holes of small diameter, say up to ⅛ in. dia, they are not easily produced by a drilling operation unless one is satisfied with a ragged finish and possibly distorted work. To obviate this a punching method may be substituted, perhaps improvising the equipment needed. Having recently had to make some detents for carburettor jet control of the type depicted in Fig. 1, I found that the only way to produce the 5/16 in. dia. hole satisfactorily was by a punching operation.

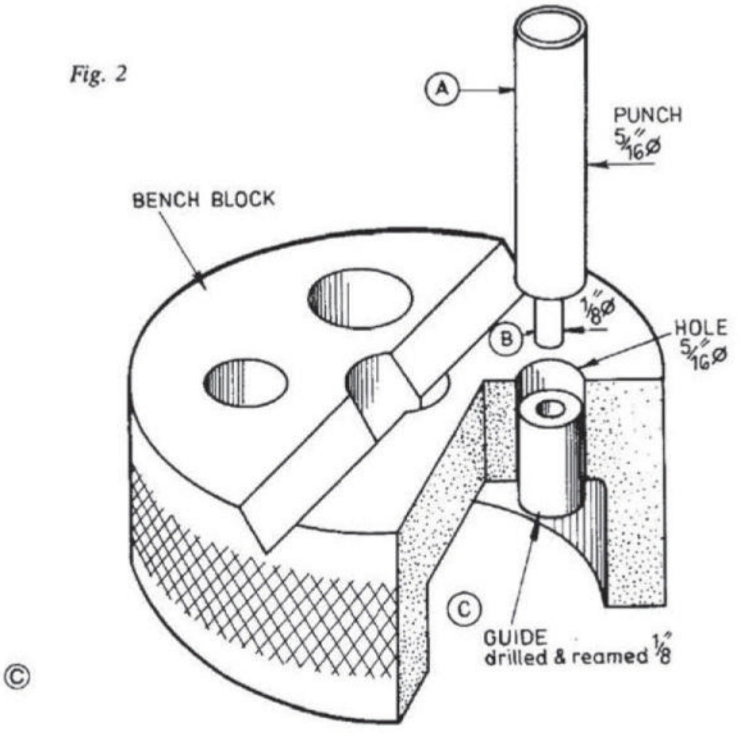
As will be seen from the diagram Fig. 2, the improvised equipment consists of a Punch A provided with an integrally machined Guide Pin B and a Guide Bush C set in a block of metal, in this case a Starrett Bench Block. This latter is a hardened component furnished with a number of standard-size holes from ¼ in. dia. to ½ in. dia. and surface-ground on its upper face. As a result, the edges of the holes are sharp, and so are well fitted to shear the metal of which the work is composed. If only a few components need to be made, a hardened bolster is not essential provided the edges of the holes in the bolster remain sharp.

Fig. 1



To use the set-up; after the work has been marked out, it is first drilled, then reamed ⅛ in. dia. before being set on the bolster and registered with the guide pin which itself is then located in the guide bush. A sharp tap with a hammer on the head of the punch itself will then complete the process.

Fig. 2



The Stanton Collection

The Stanton Collection is a family-run business that specializes in the restoration and preservation of vintage vehicles based in Ashbourne, Derbyshire.

The Collection includes a wide variety of vehicles, from classic cars and tractors to locomotives. The Stanton Collection also offers a variety of services, including restoration, repair, and maintenance, as well as appearances and hire for events and special occasions.

A 1989 Maxitrak Petrol Shunting Loco "Invicta" is an example of a locomotive currently undergoing a major overhaul in the Stanton workshops, **photo 1.** Specifically built for Markeaton Park Light Railway (MPLR), Invicta is the largest loco Maxitrak has produced. After MPLR's closure, Invicta was sold to Gulliver's Kingdom in Warrington.

The collection purchased Invicta in 2019 so that she could be reunited with her coaches and track from MPLR, which they also acquired. It has always been the owner's dream to own Invicta, even when he was volunteering as a child he saved his pocket money so that he could one day own her.

When her overhaul is complete, she will be better than new. With immaculate bodywork and many of the plastic parts originally fitted being replaced or remanufactured out of metal. Upon completion, she will be going to Sherwood Forest Railway.

In 2022 the Great Central Railway Easter vintage festival saw the first outing for Thistledown the Aveling R10 roller, **photo 2,** which had recently left the works following her 10 year hydraulic test and a few other jobs, **photo 3**.

The company's history can be

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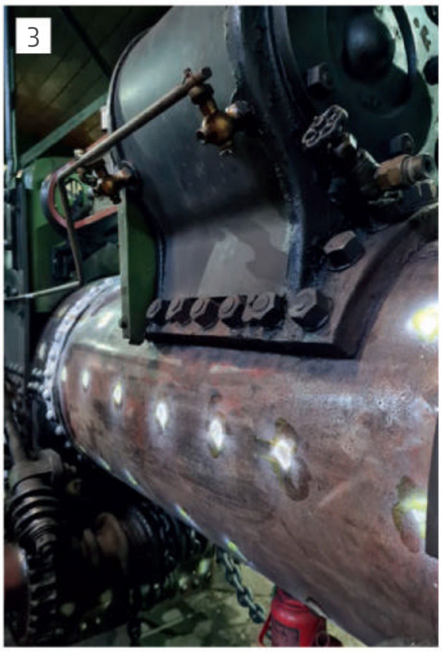


The roller's boiler stripped for inspection.

1

INVICTA
OPEN
FARES
LAST TRAIN

Maxitrack Invicta undergoing restoration.

2

Aveling R10- roller making its first excursion after overhaul.

›

4

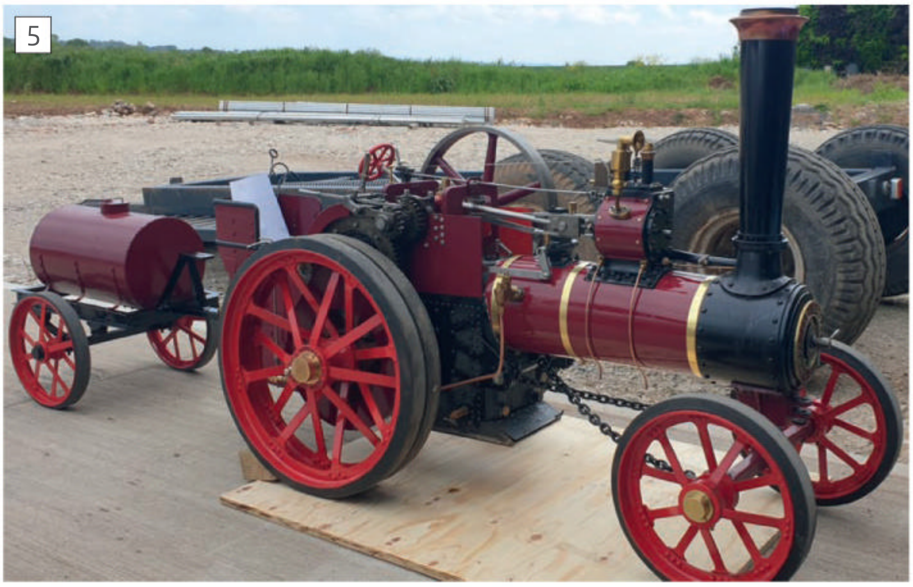
Fordson Major 'Bertha'.

traced back to owner Mat Stanton's interest in heritage engineering when he volunteered as a child at the Markeaton Park light railway. He was just eight years old when he started, and under the watchful eye of the late John Bull he was allowed to be involved with more and more as the years went on. Here he learnt the skills like specialist welding that he is now highly regarded for. John Bull Snr and his son, John Bull Jr saw the potential in Mat, who says he wouldn't be where he is now if it wasn't for them giving him the opportunities to get involved when he was young.

The collection started with his 1955 Fordson Major 'Bertha', **photo 4**, which was sold to him as scrap. He lovingly restored it, and later in its life it was upgraded with a Thames Trader six-cylinder engine. This is something that would come in handy as the business grew, without it they wouldn't have been able to move around and load railway locomotives, steam rollers or even pull five fully loaded trailers around site.

Sadly, the Markeaton railway was closed in 2016 but Mat was undeterred, continuing his restoration and fabrication services from the driveway of his parent's house. At one point he had four tractors, three trailers, a plough, and a Morris Minor all on the front garden of their cul-de-sac home. He's sure the neighbours were thrilled!

5


Four-inch traction engine with water bowser.

Fed up with working for businesses where staff weren't valued or respected, Mat wanted to break that cycle. He was spurred on to form his own company in 2020, where he could bring together good people and make sure they were treated properly. The business has attracted some of the best steam engineers, heritage vehicle specialists and coach painters in the country.

When Mat set up the business, he was not expecting the growth and adventure that was ahead of him. In just two years we went from a one-man band to a team of ten strong. From the marquee on the drive, to his first official business premises, a small barn in Leicestershire, and now to a new 3,000 sq. ft site in Ashbourne, the business keeps growing from strength to strength.

Work undertaken by the workshops includes:

Specialist welding services using various techniques on a wide range of metals, as well as non-destructive testing.

Painting and sign writing services including - coach painting, lining and gilding and signwriting.

bodywork, body panel and skin services including tig welding and seamless finishing and completeew panel fabrication.

Steam boiler services include running repairs to full boiler overhauls. These may include work such as boiler retubing, new plate work and plate forming as well as accessories such as fusible plugs, wash-out plugs, mud doors and manhole doors. As well as full size engines the workshop deals with miniature steam repairs and overhauls, **photo 5**.

The collections classic vehicle services deal with bodywork and structural repairs, including wooden frame restoration and panel replacements. The workshop can also repair and rebuild engine, gearboxes and all other parts of vehicles' running gear.

The Stanton collection is a valuable resource for enthusiasts of vintage vehicles. The collection is well-maintained and well-presented, and it offers a unique opportunity to see a wide variety of vintage vehicles. ▮

TSC
The Stanton Collection

Derbyshire based one stop restoration shop

4.5 inch Burrell, that we have just completed.

Ferguson T20 tractor, undergone body work and full repaint.

Aveling and Porter R10 steam roller, we have done the boiler and motion work.

We are an engineering business that specialises in steam engineering and vintage vehicle restoration. The Stanton Collection offers a range of services on vehicles ranging from 1" scale models to full size. The services include, boiler repairs, new build boilers, metal machining, welding services (including cast iron and copper welding), coach painting and lining, vintage vehicle restoration (from minor repairs to full overhaul). We like to make our customers happy so we take pride in your pride and joy.

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Artful Dodge #9 – Milling Tips

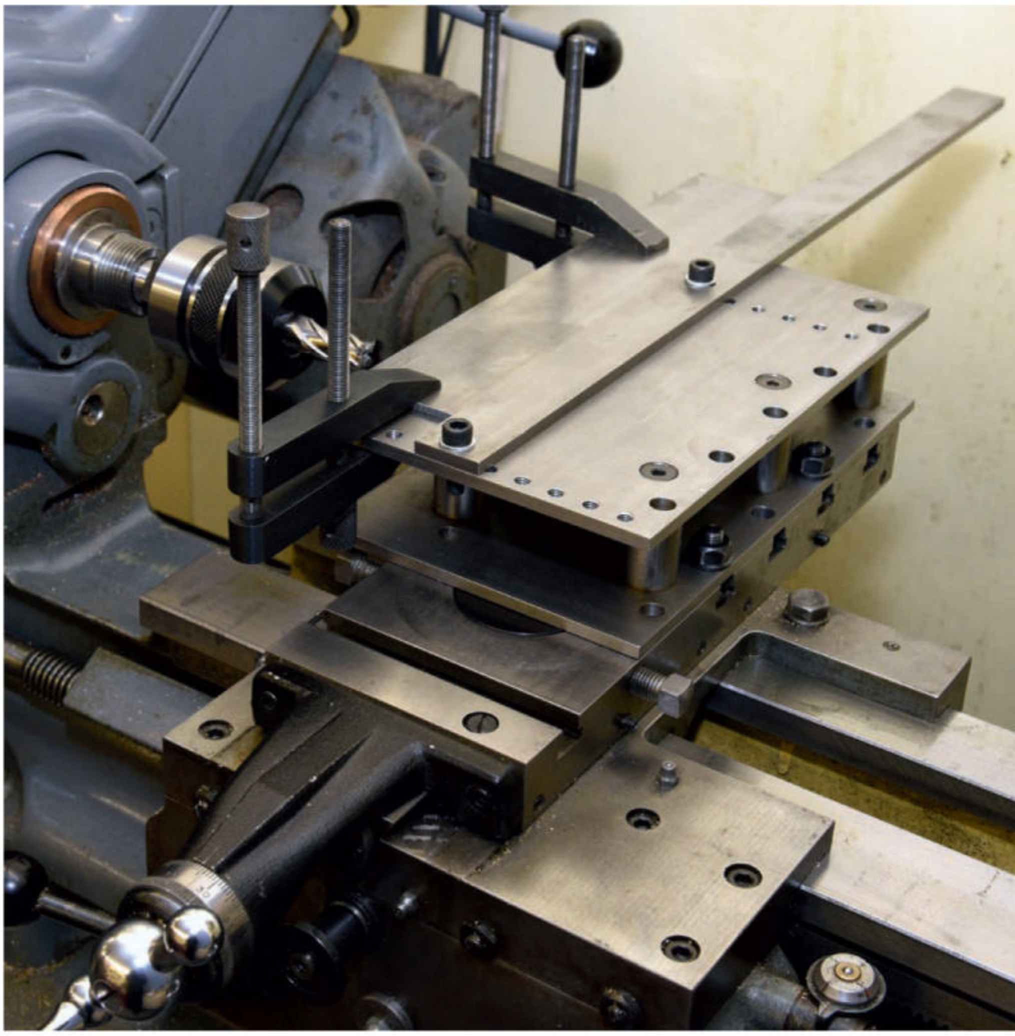
Essential reading for beginners and valuable to old hands, this series by the late John Smith shares some of his wealth of skill and experience from over half a century in hobby engineering.

Milling edge of sheet in Myford VMB.

I'll begin with a useful lathe attachment for milling the edges of flat components – like loco main-frames and stretchers. I made this for my first Myford lathe, an ML7. It's basically two rectangular 5mm mild steel plates (about 8.5" x 5"), separated by six ¾"D mild steel spacers. The spacers are tapped M6 and the holes in the plates are countersunk to suit.

Both plates have a set of ten 8.1mm holes to match the T-slot spacing on the ML7 cross-slide. All holes were drilled with both plates clamped together. The top surface of the top frame sits ¼" below the lathe centre-line, allowing a ½"D end mill held in a Clarkson-type collet chuck or a 2MT end-mill holder to run along a component clamped to the top surface using toolmakers' clamps.

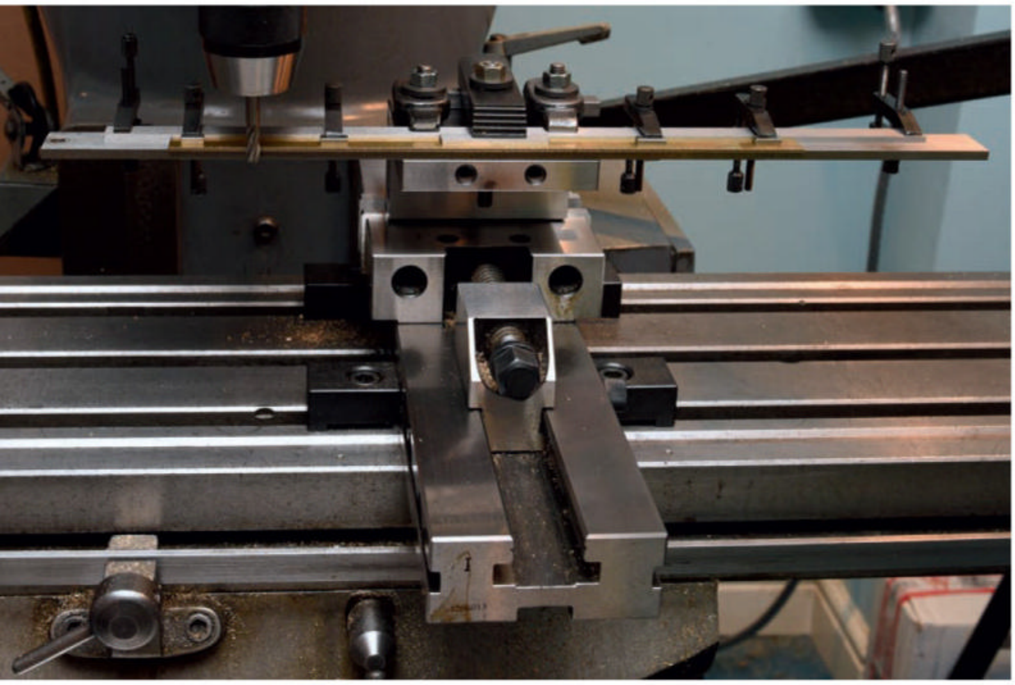
There is a series of M6 tapped holes at both ends of the top plate to allow a guide (a length of 1" x 3/16" gauge plate) to be set appropriately for the width of the workpiece. The guide is set using a dial gauge mounted on a magnetic stand sitting on the lathe bed. **Photograph 1** shows the attachment set up on my Super Seven. One has to move the clamps about a bit, but the attachment produces good results



Attachment set up on ML7 lathe.

Since I bought my Myford VMB mill and, later, my second-hand Bridgeport, all milling has been undertaken on those machines. I keep a Rohm CNC machine vice bolted to the Bridgeport table – positioned accurately with respect to the X-axis by running a dial gauge along a parallel held in the vice. Most milling is done in the vice. Although this vice has "hold-down" jaws which push the workpiece down, I mostly do not use this feature, preferring the traditional method. The workpiece is supported on two thin (1/8"/3mm) parallels, one against each jaw, and gripped lightly, then hit hard with a copper-faced hammer to force it down against the tendency of the vice jaws to lift. Then the vice is fully tightened.

The edges of sheet material can be milled by clamping it to an angle-plate gripped in the jaws, **photo 2**. Alternatively, a box angle plate is very useful for this task; I used one on the



Milling the edge of a steel strip.

VMB for years, as an end-mill gripped in a Clarkson-type collet chuck cannot reach a component bolted to the VMB table.

Long strips of sheet metal can be milled using a piece of mild steel bar or gauge plate clamped to an angle-plate held in the vice or to a box angle-plate. A guide is clamped to the bar and adjusted to be parallel to the X-axis of the machine by running a dial gauge along it. Toolmakers' clamps are perfectly adequate to hold the workpiece down, **photo 3**.

My final milling tip relates to advancing an end-mill into a corner – such as when the inside of a valve chest is milled. When this is done, cutting takes place over a full quadrant of the end mill. This increases the cutting resistance and most vertical mills will complain (You will notice a change in the tone of the motor.). The tip is to set the quill stop such that the permitted travel is just greater than the thickness of the material. You then pull the quill down against the stop, clamp it and start to mill the recess, feeding the head down (or the table up) by 0.020" or so for each cut. On the second or third cut, when the end-mill reaches a corner, you will hear the change in tone. Slacken the quill clamp, lift the tool up using the quill feed handle, advance the table to its final position and then pull the quill down to the end of its travel and clamp it. The end mill bores a beautiful quadrant, and you are ready for the next leg of the recess. ▮

MODEL ENGINEER

NEXT ISSUE

LNER B1
Doug Hewson details the valve liners for his five-inch gauge LNER B1 locomotive.

Oscillator
Luis Trincão continues his CAD exercise by drawing the piston for his oscillating engine.

Steam Engine
Ron Fitzgerald explains how an analysis carried out by Galileo demonstrated that an ellipse is the optimum shape for a beam under load.

Slotting
Jacques Maurel explains how to select the correct slotting tool to create holes of different shapes.

Signals
Mike Hanscomb explains the workings of the point actuators used on the Beer Heights Light Railway at Pecorama.

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On the **Wire** **NEWS** from the World of **Engineering**

Mintronics announce new partnership with Matterport!

Mintronics, suppliers of Alibre Atom 3D, 3D printing and scanning and other services are thrilled to announce that they have recently partnered with Matterport to offer our customers the Matterport range of digital twin hardware and software solutions.

Matterport is the industry leader for 3D space capture. Matterport's all-in-one platform transforms real-life spaces into immersive digital twin models. You can use Matterport to digitize any type of space -- from homes, offices and hotels to industrial spaces and retail outlets.

Matterport's powerful all-in-one 3D virtual tour and spatial data platform enable industries to turn any building into an accurate, immersive digital twin, providing an effective tool for connecting people with spaces, allowing for enhanced promotion, collaboration and accelerated project management.

Matterport's AI platform turns your scan into an interactive 3D model. Matterport's AI, Cortex, can identify objects within rooms, stitch all of your scans together, and reconstruct your space into an immersive virtual tour.

With Matterport software you can tailor the walkthrough to your needs. You can edit, add, modify, and annotate your space however you want.

While most of the Matterport solutions are aimed at a professional level, he Matterport Axis and Tripod is A revolutionary motorized mount for smartphone capture priced at just £79.

For more information, visit www.mintronics.co.uk/matterport.

Bristol Braille Technology to provide FIRST LEGO League programming for partially sighted and blind children

With the support of FIRST, a robotics community preparing young people for the future, the Institution of Engineering and Technology (IET) has partnered with Bristol Braille Technology (BBT) to test programming accessibility for partially sighted and blind students participating in FIRST LEGO League programs.

BBT specialises in technology for the partially sighted and blind, and their pilot project has developed braille kits to enable students to code and participate in the FIRST LEGO League program. The kits consist of a computer console that will allow partially sighted and blind students to work together to participate in the global program.

David Lakin, IET Head of Education, Safeguarding and Education Policy, says: "This has never been done before so we're really excited about its potential opportunities to open up FIRST LEGO League to more children.

A showcase took place on Wednesday 26 April at IET Stevenage: Futures Place and saw students using the new and innovative technology and putting it to work.

FIRST LEGO League introduces Science, Technology, Engineering and Mathematics (STEM) to children ages 4-16 through fun, exciting hands-on learning. FIRST LEGO League participants gain real-world problem-solving experiences through a guided, global robotics program, helping today's students and teachers build a better future together. In FIRST LEGO League, students engage in hands-on STEM experiences, building confidence, growing their knowledge, and developing habits of learning. FIRST LEGO League's three divisions inspire youth to experiment and grow their critical thinking, coding and design skills through hands-on STEM learning and robotics.

Shredded HEAT: Old railway uniforms to be recycled into insulation

Old uniforms no longer needed by Northern staff are set to be shredded and turned into 'further life products' such as insulation and sound-boarding as part of a new environmental push by the train operator.

End of life uniform will be collected from depots and train crew centres on a regular basis before being shredded and used in one of three ways by their recycling partner, Avena, a specialist in brand security through processes including textile shredding, clothing destruction and textile recycling.

Some of the material, if of a pure fibre structure, will be used to create new items of clothing; some will be used to make new products including insulation, sound boards and partition walls; and those not suitable for either of these avenues will be incinerated to create energy as an alternative to landfill.

With a nearly 7,000-strong workforce, many of whom wear uniforms and workwear, the turnover of garments through natural wear and tear alone is significant.

Many of the items feature the Northern logo and therefore have to be disposed of safely for security reasons – to avoid the possibility of items being used by those looking to impersonate rail workers and gain access to restricted areas of depots and stations.

Mike Roe, safety and environment director at Northern, said: "We already recycle 70% of our waste, but we're on a mission to get that to 74% by 2026.

Win a Clarke CBG6SC Bench Grinder with Sanding Belt and Lamp

Enter our fantastic competition in partnership with **Machine Mart** to win a Clarke CBG6SC 250W Bench Grinder with Sanding Belt and Lamp , worth £188.79.

Sharp cutting tools are vitally important in any workshop, require less effort from the user and often making for a much safer experience! That's why bench grinders are often crucial pieces of kit, and essential additions to many working environments.

Coming soon to Machine Mart's extensive metalworking range, the Clarke CBG6SC is a useful bench grinder designed to help keep drills, chisels, shears etc. in top condition as well as being generally useful for metal shaping, smoothing and polishing.

This bench grinder also includes a 2" sanding belt suitable for wood, metal and plastic, a wheel dressing tool as well as a flexible work light for maximum precision and visibility.

Other useful features of the CBG6SC include combined eye shield/spark arrestors for safe usage and a based mounted ON/OFF switch. There are also adjustable tool rests and a coolant tray. For more details, visit **https://www.machinemart.co.uk/p/6-bench-grinder-with-sanding-belt--lamp-250w/**

To enter the competition, you will need to register an account at **www.model-engineer.co.uk** (if you haven't already!), log in and go to:

http://www.model-engineer.co.uk/grinder

Where you can enter the competition by answering the simple question:

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Closing date: 16 July 2022. One entry per person. By supplying your email/address/telephone number, you agree to receive communications from Mortons Ltd and Machine Mart Machine Mart Ltd.

Salvaging two Morse taper drills

Brian Wood describes briefly what I did to bring some 'modified' Morse taper drills back into workshop use.

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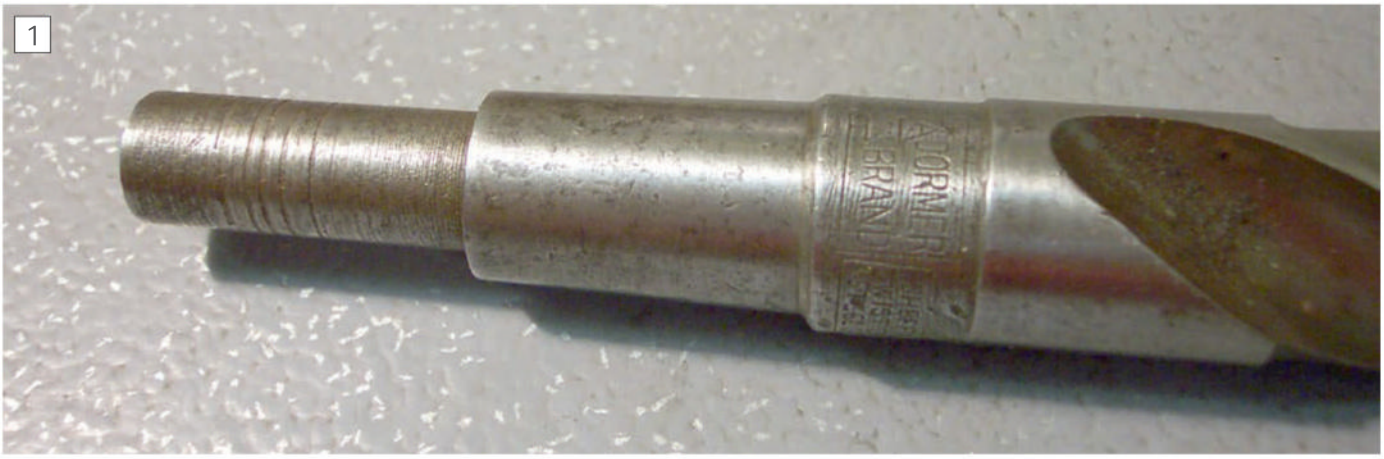

The Jacobs drill chuck conversion

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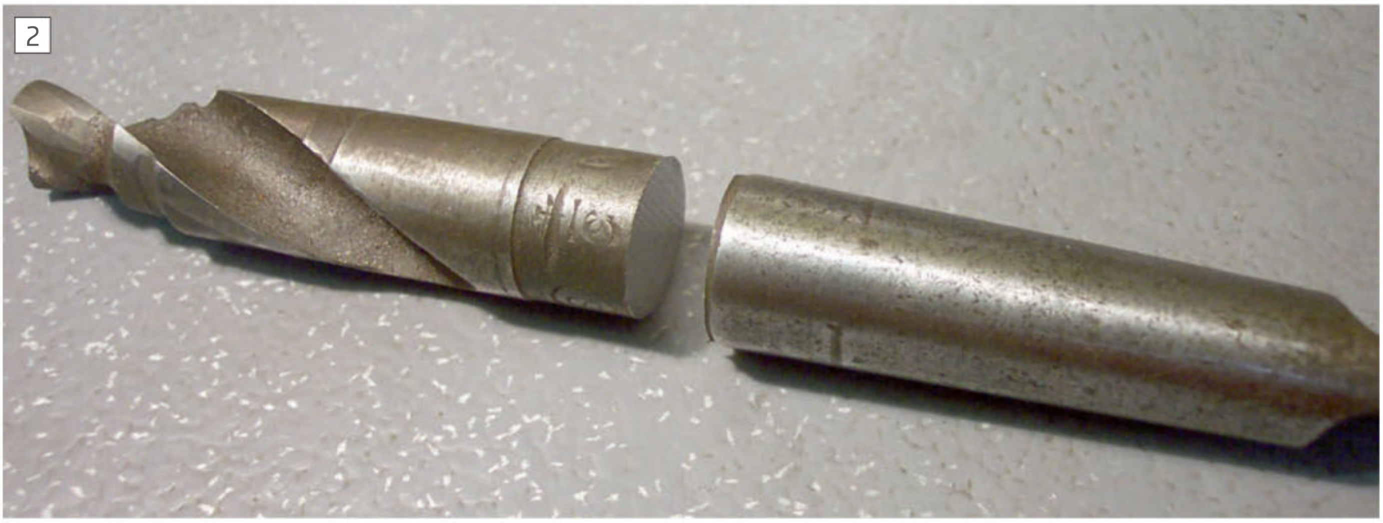

The exhausted donor drill with good 2MT taper

A good friend who goes to machinery auctions on a regular basis shared some of his recent spoils with me from one of these events. Amongst the goodies were one each of 2 and 3 Morse taper drills whose shanks had been "doctored" in the past but were otherwise in decent shape.

The Jacobs drill chuck model

Photograph 1 shows the turned down shank on a Dormer 13/16-inch diameter drill. About half the original 2MT shank had been turned down to a plain diameter but the job had been badly done with the drill flutes gripped in a lathe chuck. The plain diameter was therefore not concentric with the drill axis, the drill tip orbited very visibly. And what was left of the taper fitting was insufficient for gripping against rotational forces in a tailstock taper socket.

In this collection was a very short drill that had barely anything useful left of the business end, but it still had a good taper shank, clearly just waiting to be grafted onto the other drill. **Photograph 2** shows the donor drill just after sawing off the useful taper.

A section of steel tube in the scrap box had a thick enough wall section to make a split collet to hold the fluted body of the drill true in the lathe chuck for re-

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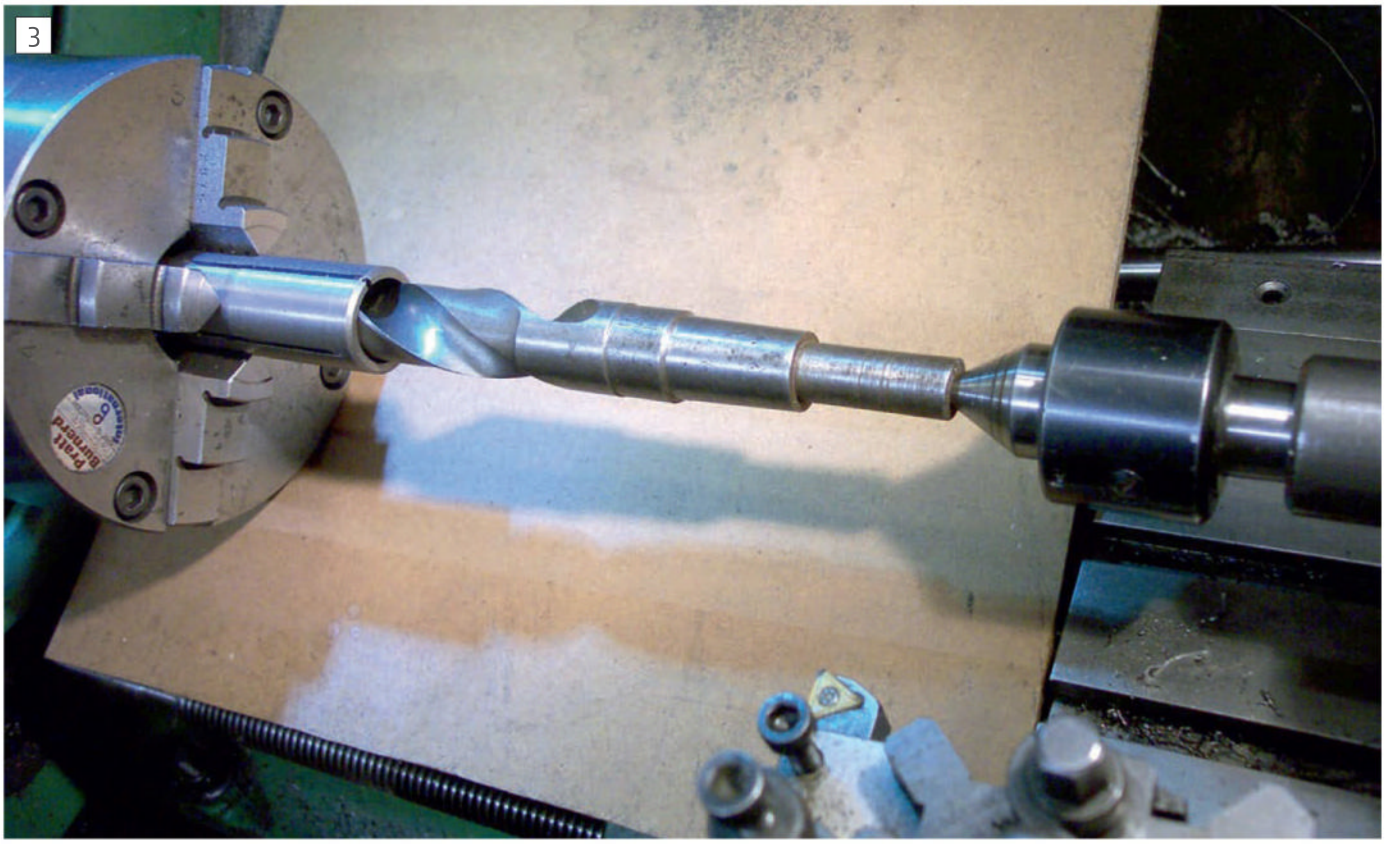

Drill re-machined to a twin spigot

machining the drive end to the shape shown in **photo 3.** The sawn-off shank from the donor drill was step drilled and then bored to make a close-fitting drive sleeve for the drill. A trial fit of the two components was very satisfactory with the tip of the drill running as true as one might wish for. Finally, a small diameter vent hole was drilled above the tang into the base of the new shank and the joint was made with Loctite 603 retaining compound**. Photograph 4** is of the joint just before assembly and **photo 5** shows the two cross pins fitted after the joint had cured.

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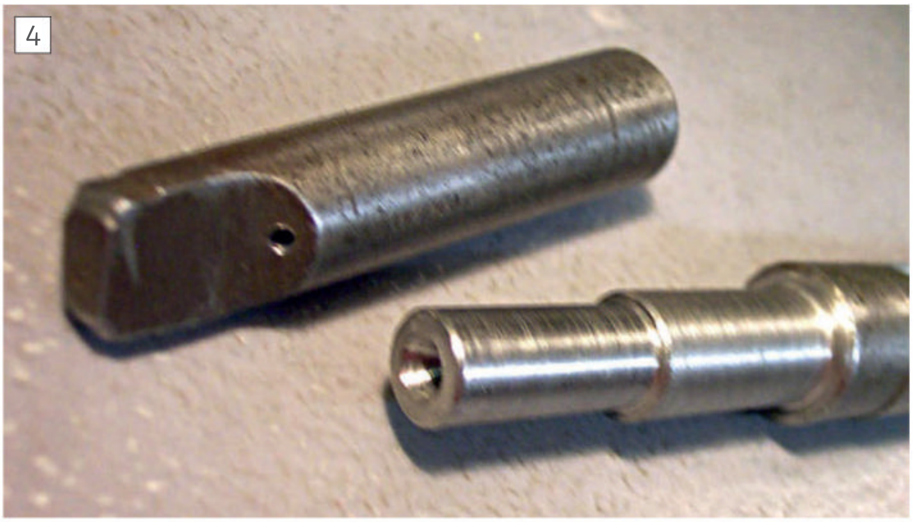


A view of the joint before assembly

The drill sleeve model

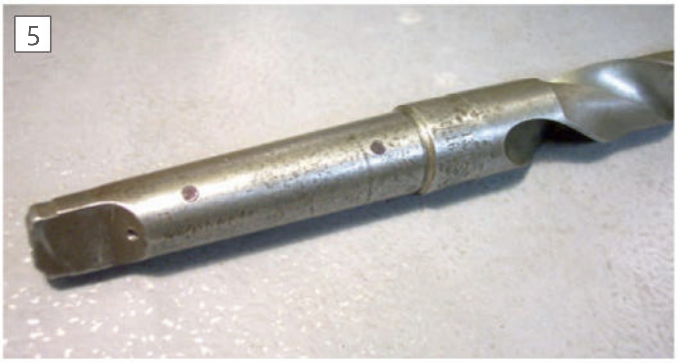
At first this appeared to be a simple job, but it turned into a very different challenge. A 2MT drill sleeve had been welded to the drive end of this drill, thereby obscuring any makers name or drill size. Alignment with the drill axis was dreadful and rendered the drill useless. Once again there was a donor component available that could be usefully repurposed.

The working end of it is shown here in **photo 6** and had at one time been a special purpose replaceable carbide tipped end mill with pumped coolant delivered through twin drillings of 1/16 inch diameter to the two small tips. Both the tips were shattered beyond identification and in this form the tool was not going to be used again. The 3MT shank however was in excellent condition and was sawn off.

This drill is 23.75 mm in diameter, so I had to make a second split collet to grip it. Fortunately, there was just enough material left of the tang end of the drill sleeve to contain a new centre hole for tailstock support to re-machine it.

The job was set up for turning and then things very quickly became difficult. The weld was so hard that carbide tips could do nothing more than ride over it to polish it up.

"Heat and slow cooling to anneal it" I thought, the old standby in such cases. The first attempt with propane heating made no impression on it at all. **Photograph 7** shows it after oxy/acetylene heating to a good red heat for several minutes followed by slow cooling during a break for lunch.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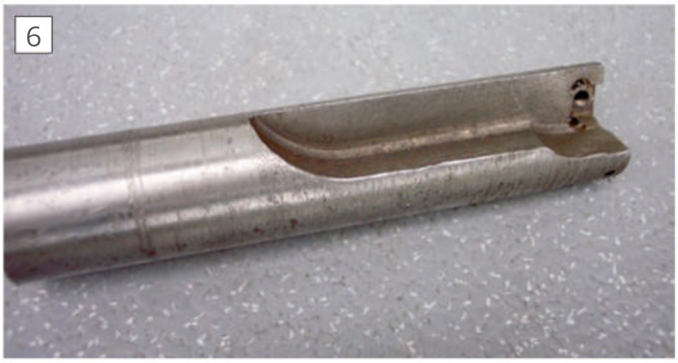
And after with two cross pins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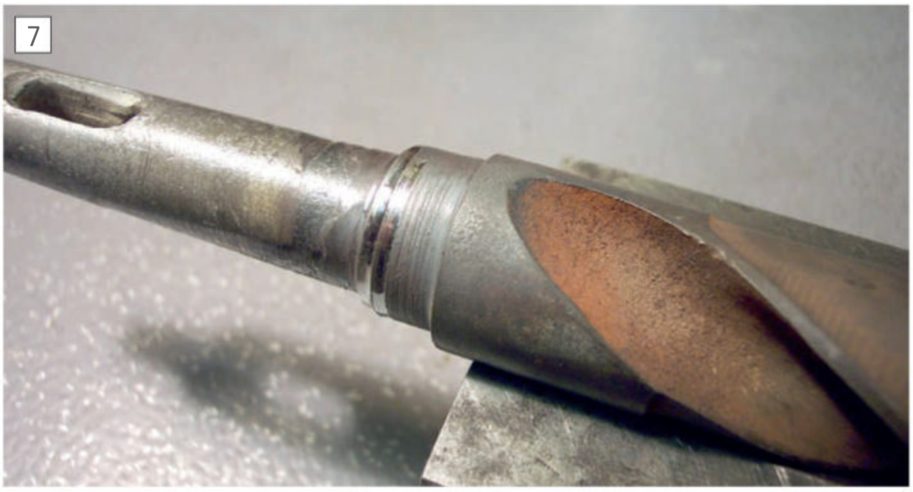
Working end of the special purpose tipped tooling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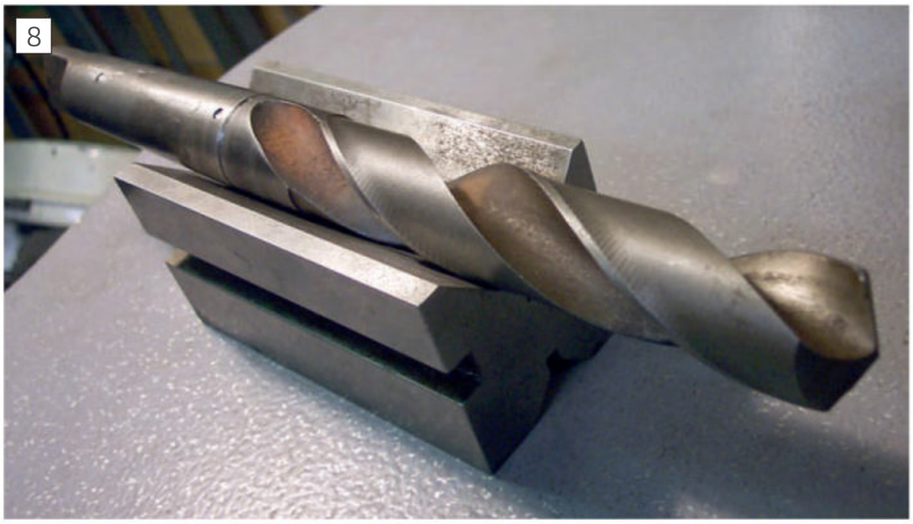
Hard weld polishing from carbide tipped lathe tooling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The finished 3 MT drill

The narrow shiny section shows the 'polishing' afterwards which was all the effect carbide tooling had on the weld, even after this degree of heating. Clearly there had been blending of the alloying elements from the drill material into the weld to impart this degree of hardness.

Time to bring on the toolpost grinder!

Things went well and once the weld had been ground, I turned my attention to the drill sleeve to dress that true along the drill axis and make a spigot of it. Once again all went well until there was a little clink noise and the drill sleeve fell off! The weld had been a simple butt weld with no Vee prep at all and I had unknowingly ground it all away. The end of the drill was flat, there had been no guide stub into the drill sleeve. It is interesting to speculate on the damage to the original taper which led to this 'repair' and it may well have been a lunchtime job done in a hurry.

A different approach was obviously called for and the drill body was drilled up inside the flutes with a ¼ inch drill until the drill protested. The hole was then opened out with a 10mm diameter solid carbide end mill to stay within the short section before the drill flutes began. Following this a section of ½ inch diameter bar was machined appropriately and brazed into the drill. The far end of the bar was left as a stub at ½ inch diameter.

The 'new' 3 MT taper section, fitted into a 3-4 MT commercial taper sleeve, was held in a 2-4 MT jump-up sleeve I made a good many years ago and bored and reamed to accept the short stub from the drill.

I drilled a clearance hole a little over 13 mm diameter down inside so that location was deliberately confined at the tail end into the reamed hole and at the drill end to where the weld had been. On a dry assembly run, the drill tip ran true, a very satisfactory result.

As in the previous case, the final joint was made with Loctite 603 but I omitted the vent hole as there was space for air to escape into in the clearance I had provided. The job was left to set with a tailstock centre providing some thrust. Two cross pins were fitted after curing at these two locations. The resulting job is shown in **photo 8**

It had not been quite the weekend job I had anticipated, but it was still a satisfying recovery with the bigger drill expected to see duty again on my Churchill lathe with its 3MT taper sockets. Purely out of curiosity I priced up these two drills as new supply: roughly £150 the pair plus VAT and delivery from one of the cheaper sites and about double that for those marked Cleveland. ▮

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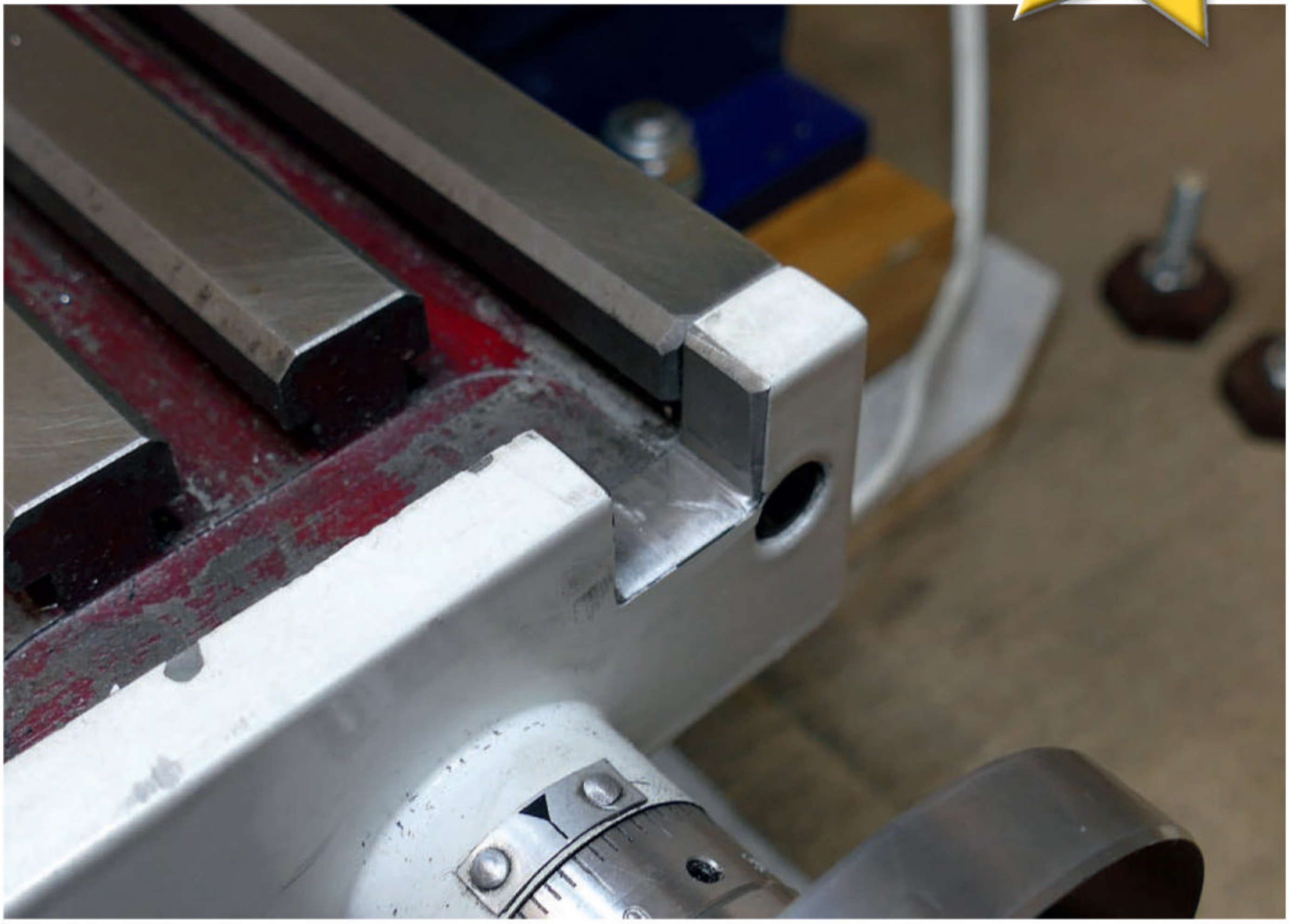
Readers' Tips

A Simple Milling Machine Modification

TIP OF THE MONTH WINNER!



This month's winner is Geoffrey Andrews who offers a small tweak to make cleaning a milling machine table much easier. Have you ever suffered the frustration of t-nuts and other accessories jamming in the slots on your mill? Do you get fed up using a brush or bit of wood to clean out the t-slots, only to find the swarf all collected in a corner but still almost impossible to get out of the slot? Read on!

If you have a mill with removable end plates, such as the Chester Conquest mill,a very small but useful modification is the cutting of a slot in the end plate of the table. What a pain it is trying to clean swarf out of the slots in the table? This small cut out now makes cleaning up simple.

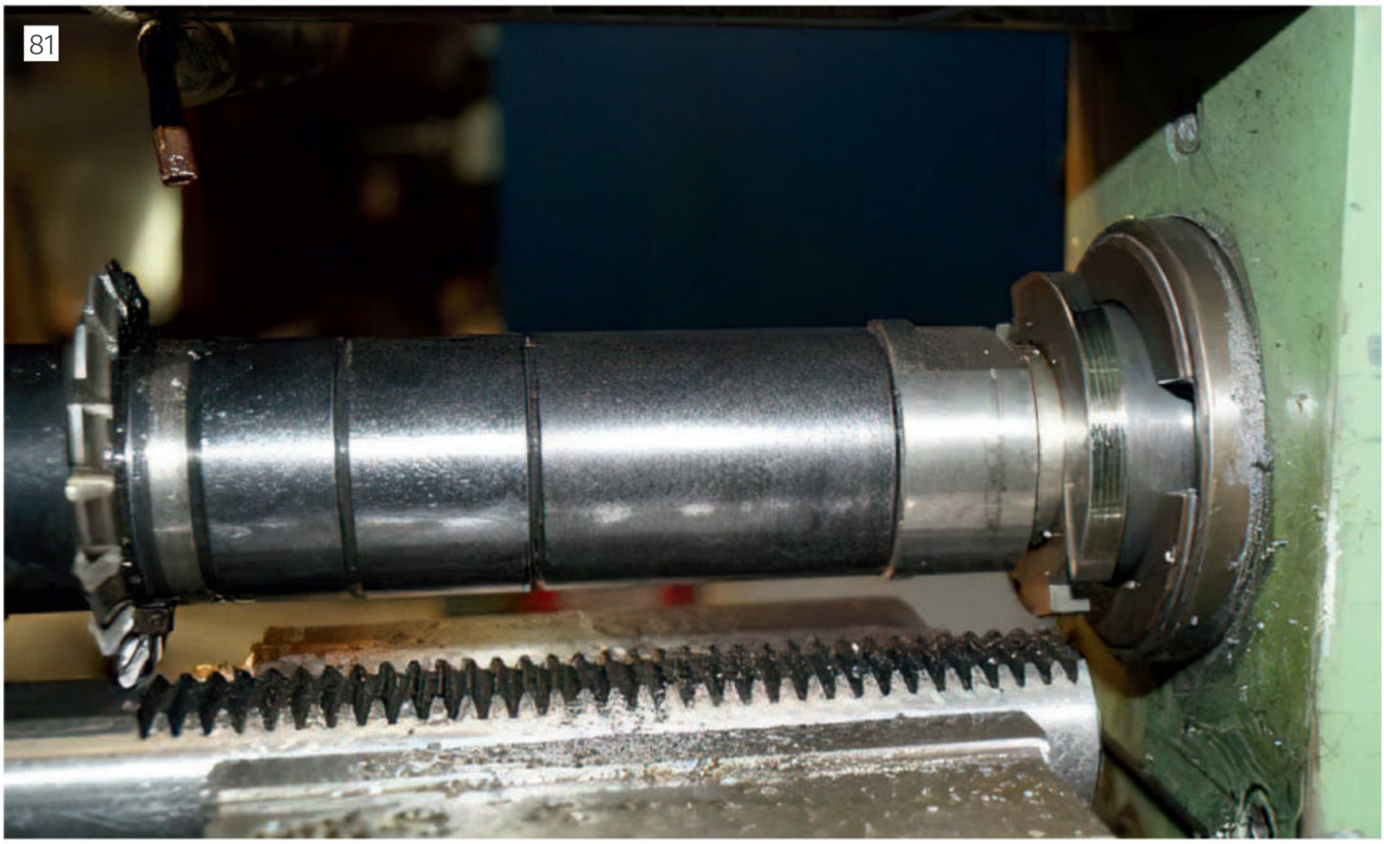
We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 600 words and a picture or drawing. Don't forget to include your address! Every month we'll choose a winner for the Tip of the Month will win **£30 in gift vouchers from Chester Machine Tools. Visit www.chesterhobbystore.com** to plan how to spend yours!

Please note that the first prize of Chester Vouchers is only available to UK readers. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.

An Improved Tailstock for A Myford Lathe, Part 4

Unfortunately the final part of Murray Lane's series on an improved tailstock for a Myford lathe went astray. Parts 1-3 appears in MEW 321, 316 and 317. Note that photos 75 to 80 appeared in issue 317.

81



Cutting the rack.

Start by drilling out the bore as smoothly as posible from one end, **photos 75** and **77**, and turn the 2MT as shown in **photo 78**. Chamfer the corner at the MT end immediately without removing from the chuck to ensure that it is concentric.

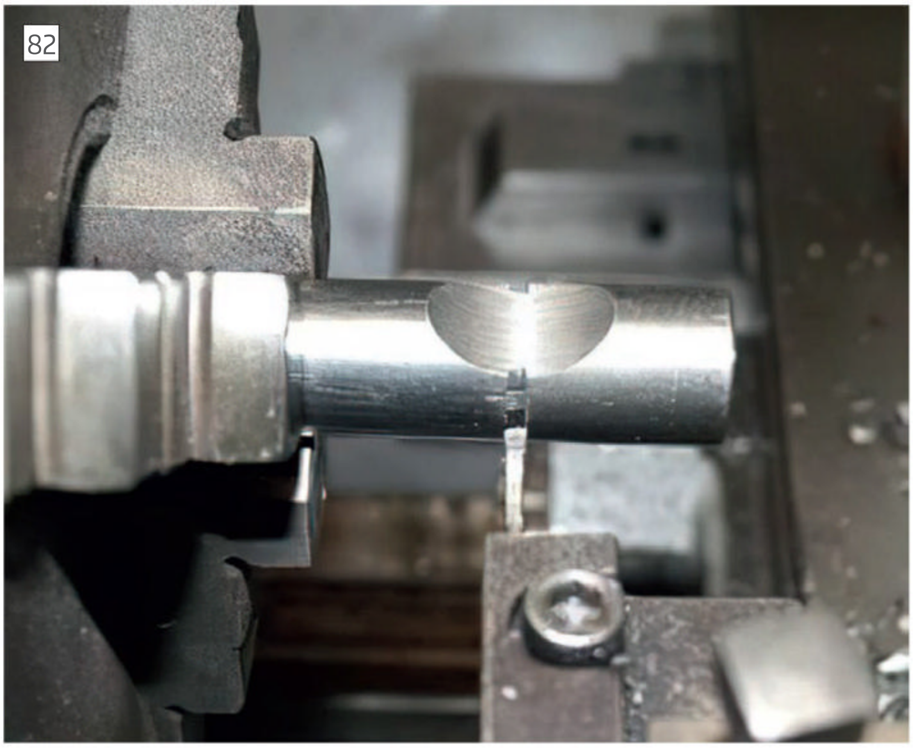
Reverse in the chuck and bore to meet the hole. Mount between centres and turn, **photo 76**, to 32.5mm with around three thou allowance for grinding which should be done commercially to a very good finish.

Machine a flat at the far end from the Morse Taper after the bar has been ground to the dimensions shown on fig. 13. This could be done as shown in **photo 79** with a couple of ground spacers in a vice; the teeth should be cut while in this position, just rember all measurements are crtical. If the rack has to be cut by a specilist it would be best if the same firm also cut the flat.

I found that it was worth while doing some experimental depth of cuts in in a test bar, **photo 80**, as the finished barrel bore will depend on the final size and managed to reduce the back lash between the rack and the pinion to 1/10th of a thou.

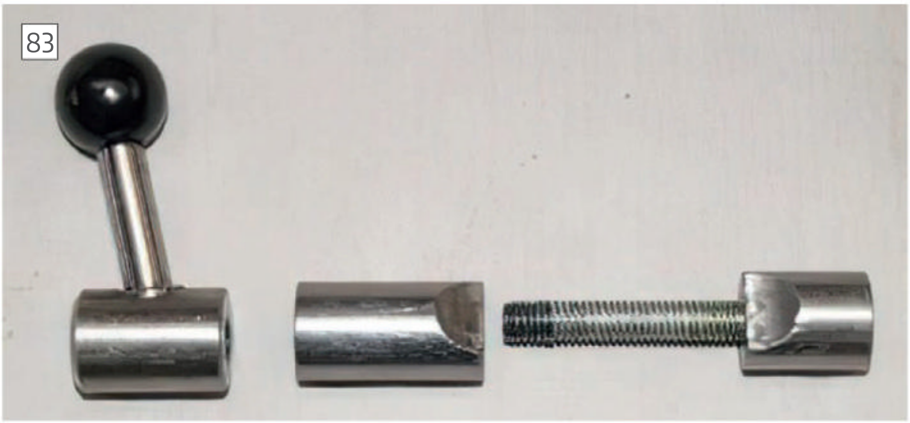
Due to the short horizontal mandrel on the FP1 Deckel mill the maximum Y travel that I was only able to cut 130mm, **photo 81**. This will probally be a job that will need to be done by a commercial workshop. There several reasons for milling the rack the full width of the pinion gear. Although it is common practice to machine racks

82



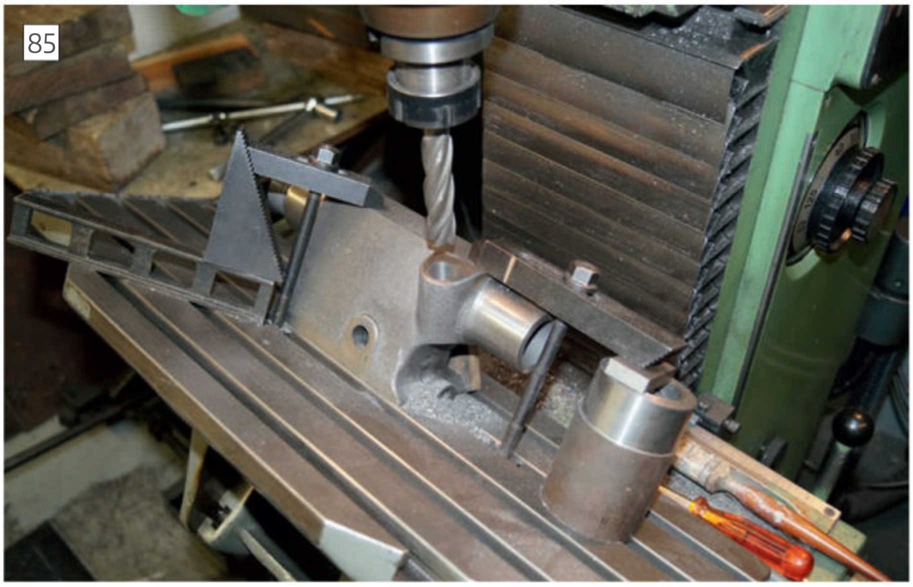
Parting off the lock bushes.

83



Barrel lock parts.

85



Drilling the barrel lock bore.

84

Mounted on the tailstock.

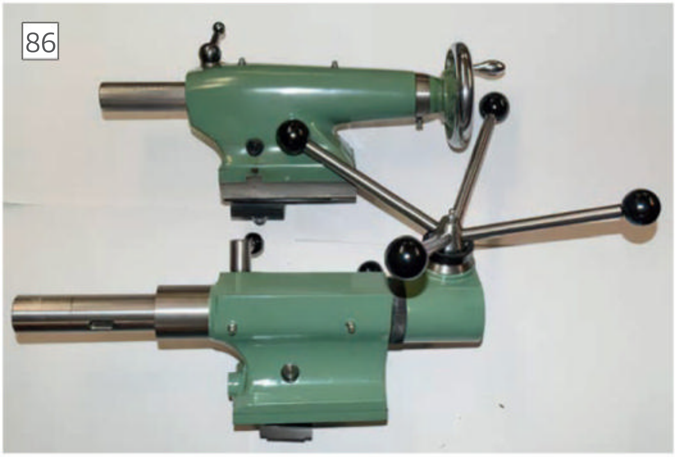
such as used in vertical heads and other similar situations across the curve of the cylinder, I personally do not think that this good engineering practice. There are several good reasons to have a full width rack teeth. The rack is much stronger and the rack and pinion together allows the rack and pinion gear box to rotate the barrel around the the tail stock bore. This allows the rack handles to be set to any radial position required. It also does away with the requirement to have a longitudinal key way to prevent the barrel from rotating.

Fig. 14 Barrel lock.

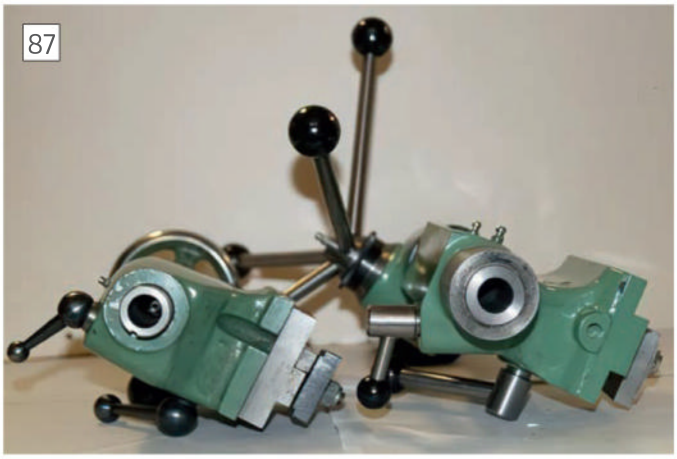
The barrel lock is the same type as used in the original Myford tailstock and is made of mild steel. Most of the work is straight forward turning the spherical cut out on the clamping bushes needs to be done to 23mm radius 3.5mm deep being the same diameter as the barrel as shown in fig. 14. As the position of the 18mm bore and and angle have a bearing on these dimentions check that the barrel is a neat fit in the cut out. Drill the clamp right through with a 6.8mm diameter drill and part off in the middle of the cutout, **photo 82**, with a 1.5mm parting tool. Tap the short bottom part with an 8mm tap and drill out the top section to 8mm diameter. Cut a suitable length of 8mm threaded rod for the stem and loctite in the bottom section, **photo 83**, Machine a small chamfer on all the corners. **Photograph 84** shows a test fit of the lock to the tailstock.

The barrel was clamped on the angular tabel on the Deckel mill, **photo 85**,and the face and bore machined as per Fig. 5. With hind sight it would have be much easier to mount the body in a

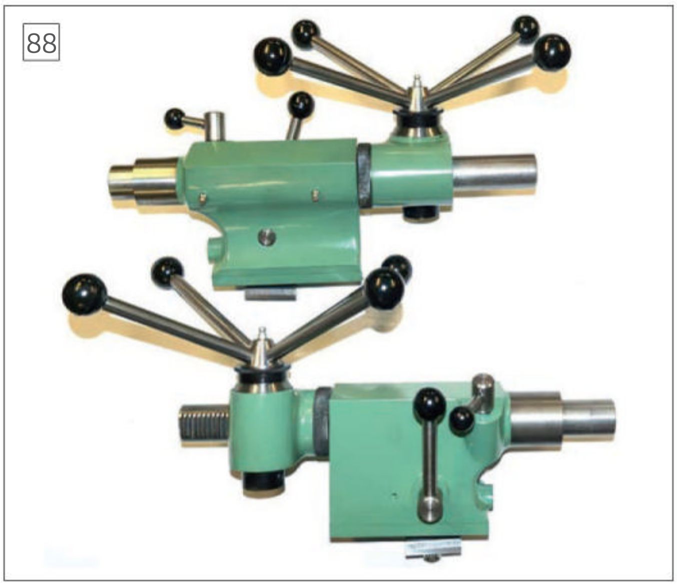
›



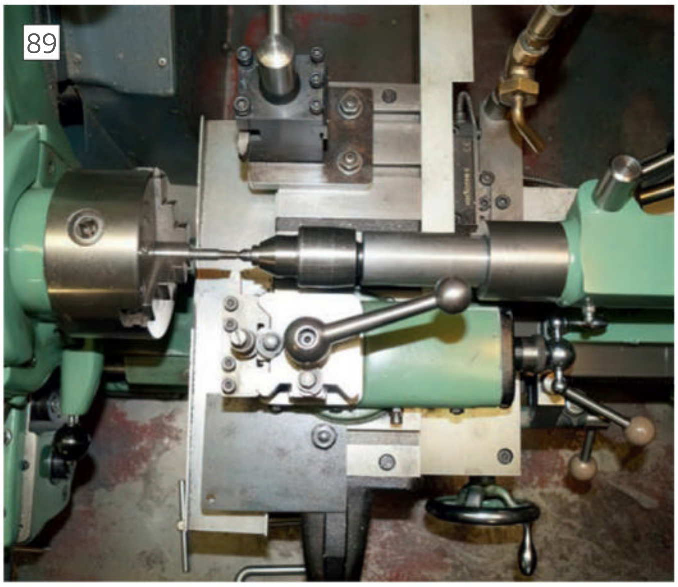
Old and new tailstocks compared.



End view of old and new tailstocks.



Opposite sides of the two tailstocks.



Tailstock fitted to lathe.

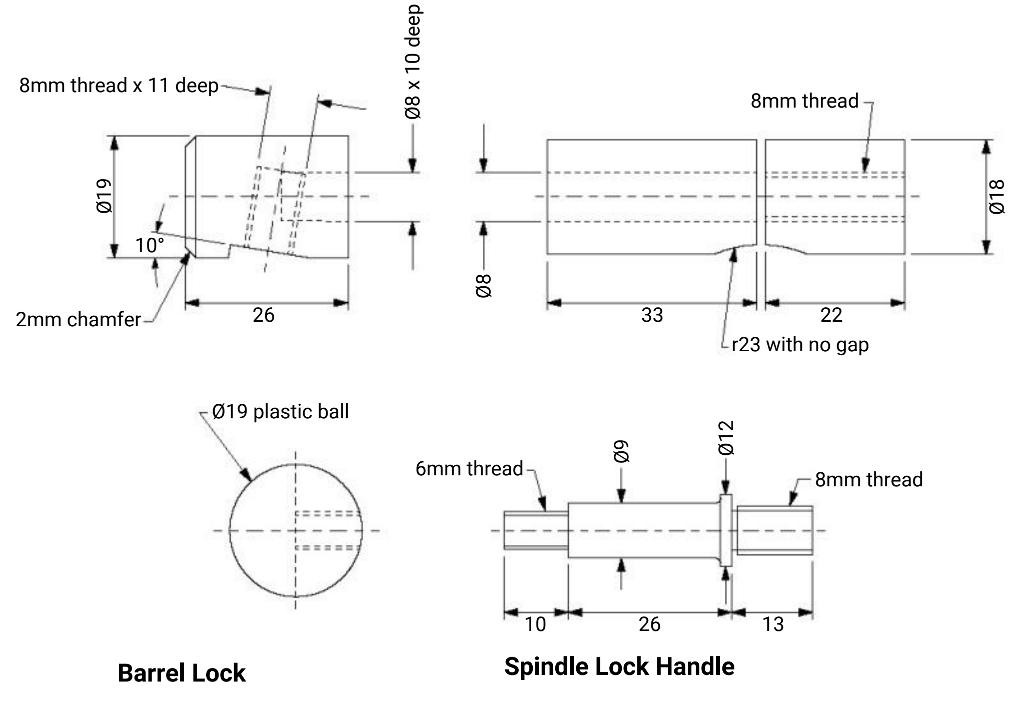
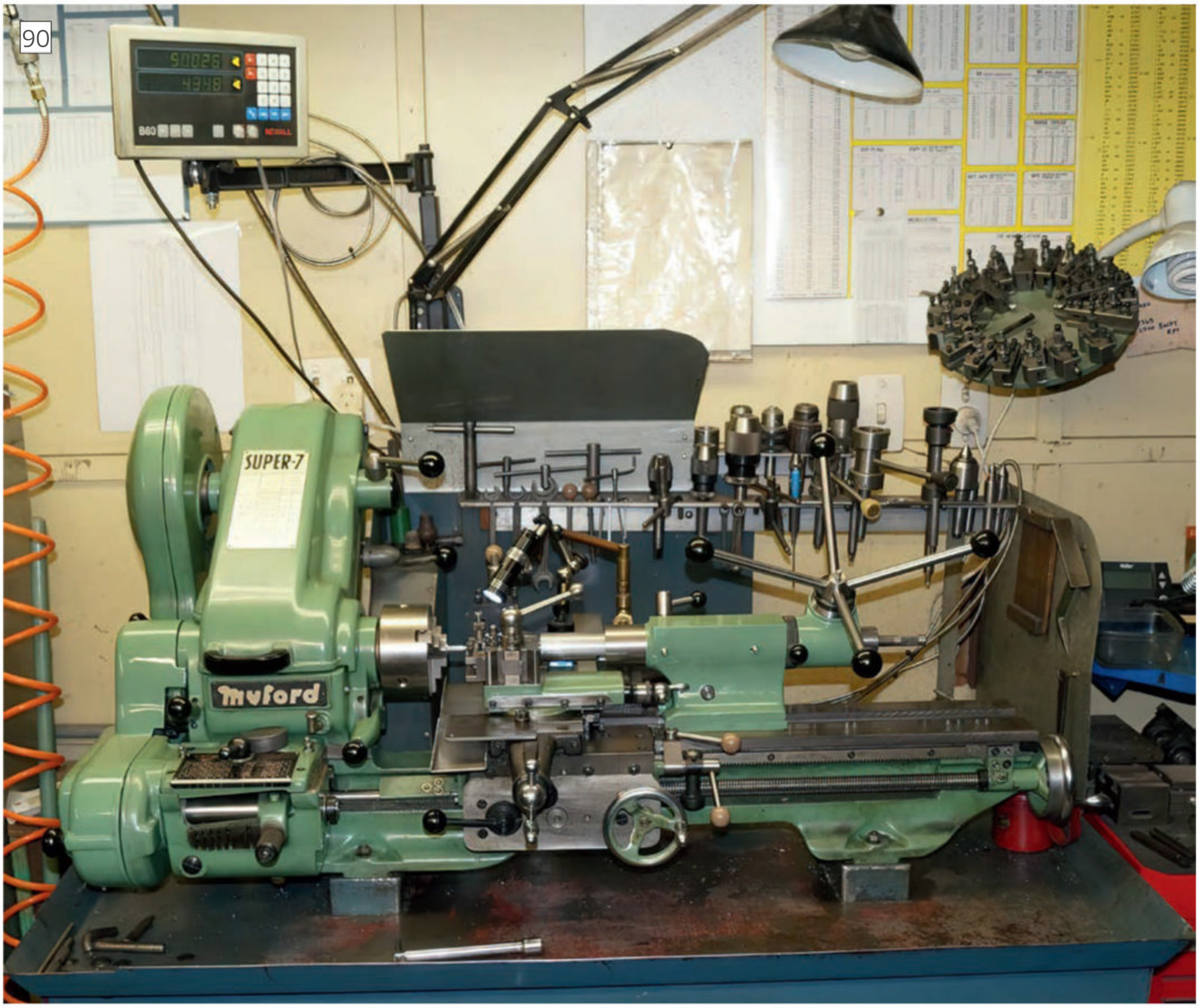

8mm thread x 11 deep
Ø8 x 10 deep
Ø19
10°
2mm chamfer
26
8mm thread
Ø8
Ø18
33
22
r23 with no gap
Ø19 plastic ball
6mm thread
Ø9
Ø12
8mm thread
10
26
13
Barrel Lock
Spindle Lock Handle

Figure 14

90


SUPER-7
Myford

General view of the lathe with the tailstock mounted on the bed.

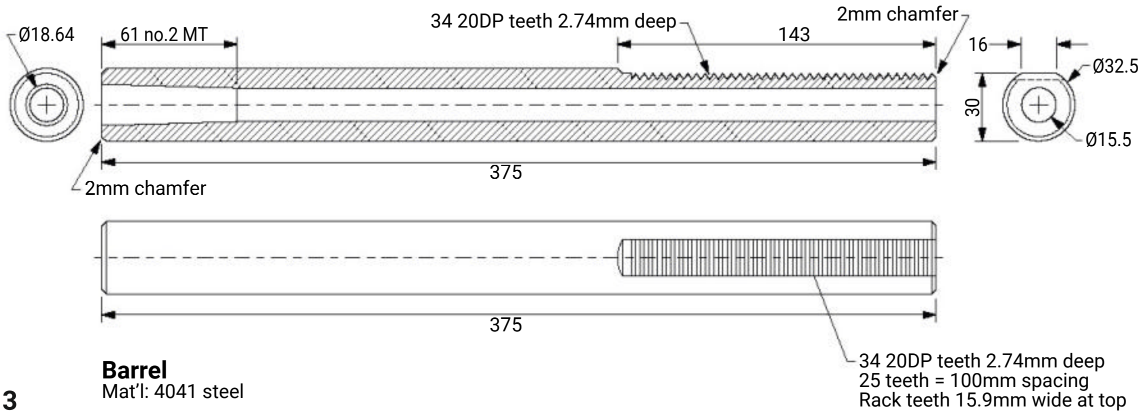

Ø18.64
61 no.2 MT
34 20DP teeth 2.74mm deep
143
2mm chamfer
16
Ø32.5
30
Ø15.5
375
2mm chamfer
375
34 20DP teeth 2.74mm deep
25 teeth = 100mm spacing
Rack teeth 15.9mm wide at top
Barrel
Mat'l: 4041 steel

Figure 13

vertical swivelling vice or set the quill over as required and bore down with it if your milling machine has enough verical travel.

Photographs 86 and **87** show the difference between an original Myford tail stock and the new design tail stock.

Photograph 88 shows the two tail stocks made showing both of the sides. **Photograph 89** shows how the tail stock can get in close to a the work piece

Finally, **photo 90** shows the tailstock fitted, this view also shows the rear catilever tool post with a tool for facing and chamfering and a parting tool when rotated 180° and a plate on front edge of the cross slide to mount a DTI stand. ∎

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- For sale Boley Lathe, 36" O/A length, 7" swing, 3 Jaw – 4 Jaw – Jacobs chucks, collets, face plates, vertical slide, fixed steady, T rest, £700 ono. **T. 01722 322773. Salisbury.**

- Warco lathe WM240, variable speed on stand, 40 fittings including 2 chucks, excellent condition. £1,800. **T. 01361 883392. Scottish Borders.**

- Warco milling machine WM-16 variable speed 120 accessories, excellent condition. £1,300. Buyer collects. **T. 01361 883392. Scottish Borders.**

Parts and Materials

- Practically complete set of bronze castings for antique twin cylinder mill engine. Cylinders, bore 1.625" x 5" long, twin beds 21.75" x 3.5". Approx. 15kg. Price-£800. **T 01202529452. Bournemouth.**

- Due retirement, unused propane gas burner & regulator designed and built. in USA specifically to fit Simplex firebox (cost £500! - bills available)..Photos Available. Modest Offers. **nev.boulton@outlook.con. Devizes.**

- Full kit of un-machined parts for Stuart No 4. £350. **T 01202529452. Bournemouth.**

- Princess of Wales, full set of loco and tender wheel castings, mostly un-machined plus inner and outer loco mainframes and bogie side frames. £450. **T 01202529452. Bournemouth.**

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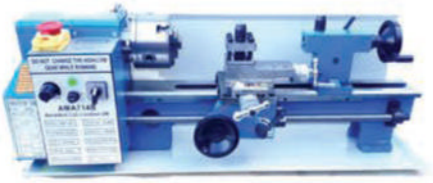
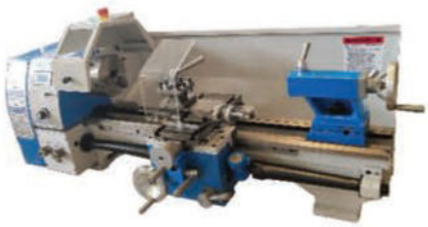


AMA714B Mini lathe
Brushless Motor

SPECIFICATION:
Distance between centers: 350mm
Taper of spindle bore: MT3
Spindle bore: 20mm
Number of spindle speeds: Variable
Range of spindle speeds: 100-2250mm
Weight: 43Kg

Price: £694



AMABL250Fx750

SPECIFICATION:
Distance between centers: 750mm
Taper of spindle bore: MT4
Spindle bore: 26mm
Number of spindle speeds: Variable
Range of spindle speeds: 50~2500rpm
Weight: 140Kg

Price: £1,904
W 2 Axis DRO - Price: £2,280

AMABL290VF Bench Lathe (11x27) - power cross feed - BRUSHLESS MOTOR

SPECIFICATION:

Distance between centers: 700mm
Taper of spindle bore: MT5
Taper of tailstock quill: MT3
Motor: 1.5kw
Weight: 230Kg

Price: £2,782
W 2 Axis DRO – Price: £3,150

AMAVM25LV

SPECIFICATION:
Model No: AMAVM25LV (MT3) / (R8)
Max. face milling capacity: 63mm
Table size: 700×180mm
T-slot size: 12mm
Weight: 120Kg

Price: £1,431.00
W AXIS POWERFEED - Price: £1,659
W DRO – Price: £1,921
W DRO + PF - Price: £2,210

E3 Mill R8 Metric Brushless Motor

SPECIFICATION:
Max. drilling capacity: 32mm
Max. end milling capacity: 20 mm
Max. face milling capacity: 76mm
Motor: Input- 1.5KW
Packing size: 1050x740x1150mm
Net weight: 240kg

Price: £2,560.00

AMAVM32LV

SPECIFICATION:
Model No: AMAVM32LV (MT3) / (R8)
Max. face milling capacity: 76mm
Table size: 840×210mm
T-slot size: 14mm
Weight: 240Kg

Price: £2,100.00
W DRO – Price: £2,537
W DRO + PF - Price: £2,948

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The Model

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This development of this model has been supervised by our award winning professional engineer Mike Pavie and the batch is being built by the same manufacturer who supplied our much acclaimed Coronation Class locomotive.

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Summary Specification

- Coal-fired live steam
- Silver soldered copper boiler
- Reverser
- Working drain cocks
- Stainless steel motion
- Safety valves
- 3 cylinders
- Boiler feed by axle pump, injector, hand pump
- Bronze cylinders with stainless steel pistons and valves
- Sprung axle boxes with needle roller bearings
- Piston valves
- Mechanical lubricator
- Outside Walschaerts valve gear
- Multi-element superheater
- Etched brass bodywork
- Choice of liveries
- Choice of nameplate
- Fully painted and lined
- Ready-to-run

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  Width 9.5"
  Height 14"
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